NFPA® 13R

Standard for the Installation of Sprinkler Systems In Low-Rise Residential Occupancies

2016 Edition

NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

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NFPA® 13R

Standard for the

Installation of Sprinkler Systems in Low-Rise Residential Occupancies

2016 Edition

This edition of NFPA 13R, *Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies*, was prepared by the Technical Committee on Residential Sprinkler Systems, released by the Correlating Committee on Automatic Sprinkler Systems, and acted on by NFPA at its June Association Technical Meeting held June 22–25, 2015, in Chicago, IL. It was issued by the Standards Council on August 18, 2015, with an effective date of September 7, 2015, and supersedes all previous editions.

This edition of NFPA 13R was approved as an American National Standard on September 7, 2015.

Origin and Development of NFPA 13R

The first edition of NFPA 13R, which was published in 1989, represented a milestone in the development of sprinkler installation design standards. The first edition resulted in a standard for the protection of low-rise residential facilities.

This standard is intended to provide a higher degree of life safety and property protection to the inhabitants of low-rise multifamily dwellings. Promulgated as a document that provides for increased levels of protection to building occupants, the document also considers the economic aspects of a sprinklered facility as compared to an unsprinklered facility.

As the number of states and cities that implement sprinkler ordinances continues to grow, and as the threshold levels for sprinkler requirements in residential occupancies in the building codes extend to certain low-rise structures, it is believed that systems for certain residential occupancies can be efficiently and effectively installed in accordance with this standard.

The 1994 edition provided expanded information on nonmetallic pipe materials, made minor changes to clarify the established design criteria, and added a new recommendation on underground pipe materials.

The 1996 edition included several changes that paralleled amendments in the 1996 edition of NFPA 13, *Standard for the Installation of Sprinkler Systems*. Other changes included a number of clarifications concerning the selection of sprinklers as well as the proper use of sprinklers.

The 1999 edition clarified criteria for nonmetallic pipe and fittings and established a minimum operating pressure for sprinklers. Guidance on providing freeze protection using insulation in attics and antifreeze systems was provided, as was information on the application of solvent cement for nonmetallic piping. Exceptions for omitting sprinkler coverage in closets on balconies and underneath garage doors were added.

The 2002 edition incorporated revisions to update the standard to comply with the 2000 edition of the *Manual of Style for NFPA Technical Committee Documents*. These revisions included editorially rewording any exceptions as requirements. The 2002 edition also included changes that further clarified the scope of the standard, established a minimum design discharge density, and added protection requirements specifically for garages. The section addressing spaces where sprinklers are permitted to be omitted was changed so that the area of full-height tub/shower enclosures would be included in the area determination for bathrooms, sprinklers would be provided in concealed spaces with fuel-fired equipment, and the omission of sprinklers in elevator machine rooms would not be dependent on the room's location.

The 2007 edition included spacing and obstruction rules addressing sloped ceilings, ceiling pockets, ceiling fans, and kitchen cabinets. For the 2007 edition, the requirements for utilizing quick-response sprinklers within NFPA 13R regulations were clarified, and new requirements addressing architectural features within dwelling units were added. Additionally,

the requirements covering closets, including obstructions within closets and protection of mechanical closets, were clarified. Finally, new NFPA 13 requirements were added that are applicable to NFPA 13R to ensure proper administration of those requirements where relevant.

The 2010 edition was reorganized, dividing out material on installation, discharge, plans and calculation, water supplies, acceptance testing, and care and maintenance into separate chapters. Clarification was provided in the Annex A material of Chapter 1 for assistance in determining when NFPA 13R is applicable and establishing that the building code defines the structure. NFPA 13R is used after such determination has been made. Further clarification was also added stating that sprinklers are not required on balconies or balcony closets.

The 2013 edition revised the title to address low-rise residential occupancies instead of addressing the number of stories outlined in the document scope. Several sections were added to address the concept of shadow areas in different configurations within NFPA 13R protected structures. The requirements for locations of sprinklers were updated to provide specific direction on protection of porte cocheres, closets, and areas outside the dwelling unit. New language addressing the number of heads to be calculated for certain sloped and beamed ceiling configurations was added based on a Fire Protection Research Foundation Report.

Several significant revisions were made during the development of the 2016 edition. The definition of sprinkler system has been revised to correlate with NFPA 13 and NFPA 25. The Annex A text for the Scope statement of the document has been significantly revised to address mixed-use buildings and the applicability of NFPA 13R systems. Clarification has been added that once a sprinkler is removed from a fitting or welded outlet it should not be reinstalled if torque was applied to the sprinkler itself. Nonmetallic piping compatibility language has been updated for consistency with NFPA 13. The section addressing sprinkler protection outside dwelling units has been reorganized and restructured to make it easier for the user to follow. Language has been added to address sprinkler protection where the device is intended to protect a glazing assembly. One of the largest changes to the 2016 edition of NFPA 13R is the review of all metric conversions. Historically the document has used an “exact” conversion process, but in the 2016 edition an approximate conversion process is used. The intent of this change is to make the document more usable outside the United States.

Correlating Committee on Automatic Sprinkler Systems

Kenneth W. Linder, *Chair*
Swiss Re, CT [I]

Jose R. Baz, JRB Associates Group Inc., FL [M]
Rep. NFPA Latin American Section
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Russell P. Fleming, National Fire Sprinkler Association, Inc., NY [M]
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Michael J. Friedman, Friedman Consulting, Inc., MD [SE]
Raymond A. Grill, Arup, DC [SE]
Luke Hilton, Liberty Mutual Property, NC [I]
Alex Hoffman, Viking Fire Protection Inc., Canada [IM]
Rep. Canadian Automatic Sprinkler Association
Roland J. Huggins, American Fire Sprinkler Association, Inc., TX [IM]
Sultan M. Javeri, SC Engineering, France [IM]
Charles W. Ketner, National Automatic Sprinkler Fitters LU 669, MD [L]
Rep. United Assn. of Journeymen & Apprentices of the Plumbing & Pipe Fitting Industry
Andrew Kim, National Research Council of Canada, Canada [RT]
John A. LeBlanc, FM Global, MA [I]
David O. Lowrey, City of Boulder Fire Rescue, CO [E]
Brock Mitchell, Extended Stay Hotels, NC [U]
Garner A. Palenske, Aon Fire Protection Engineering Corporation, CA [I]
J. William Sheppard, Sheppard & Associates, LLC, MI [SE]
Douglas Paul Stultz, U.S. Department of the Navy, VA [E]
J. Michael Thompson, The Protection Engineering Group, PC, VA [SE]
Lynn K. Underwood, Axis U.S. Property, IL [I]

Alternates

Donald D. Becker, RJC & Associates, Inc., IA [IM]
(Alt. to R. J. Huggins)
Ralph E. Bless, Jr., Telgian Corporation, GA [U]
(Alt. to T. D. Bellamy)
Brian Paul Carnazza, U.S. Department of the Navy, VA [E]
(Alt. to D. P. Stultz)
James P. Carroll, Liberty Mutual Insurance, FL [I]
(Alt. to L. Hilton)
David B. Fuller, FM Global, MA [I]
(Alt. to J. A. LeBlanc)
James G. Gallup, Aon Fire Protection Engineering Corporation, AZ [I]
(Alt. to G. A. Palenske)
Jeffrey E. Harper, Hughes Associates/RJA Group, IL [SE]
(Alt. to R. A. Grill)
Jeff Hebenstreit, UL LLC, IL [RT]
(Alt. to K. M. Bell)
Scott T. Martorano, The Viking Corporation, MI [M]
(Alt. to S. T. Franson)
John G. O'Neill, The Protection Engineering Group, PC, VA [SE]
(Alt. to J. M. Thompson)
Donato A. Pirro, Electro Sistemas De Panama, S.A., Panama [M]
(Alt. to J. R. Baz)
Jason W. Ryckman, Canadian Automatic Sprinkler Association, Canada [IM]
(Alt. to A. Hoffman)
Adam Seghi, Coda Risk Analysis, TX [I]
(Alt. to L. K. Underwood)
Joseph Su, National Research Council of Canada, Canada [RT]
(Alt. to A. Kim)

Nonvoting

James B. Biggins, Global Risk Consultants Corporation, IL [SE]
Rep. TC on Hanging & Bracing of Water-Based Systems
Robert G. Caputo, Fire & Life Safety America, CA [SE]
Rep. TC on Foam-Water Sprinklers
William E. Koffel, Koffel Associates, Inc., MD [SE]
Rep. Safety to Life Correlating Committee
Russell B. Leavitt, Telgian Corporation, AZ [U]
Rep. TC on Sprinkler System Discharge Criteria
Joe W. Noble, Noble Consulting Services, LLC, NV [E]
Rep. TC on Sprinkler System Installation Criteria
Maurice M. Pilette, Mechanical Designs Ltd., MA [SE]
Rep. TC on Residential Sprinkler Systems
Kenneth W. Wagoner, Parsley Consulting Engineers, CA [SE]
Rep. TC on Private Water Supply Piping Systems
John J. Walsh, UA Joint Apprenticeship Committee Local 669, MD [SE]
Rep. United Assn. of Journeymen & Apprentices of the Plumbing & Pipe Fitting Industry
(Member Emeritus)

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Committee Scope: This Committee shall have overall responsibility for documents that pertain to the criteria for the design and installation of automatic, open and foam-water sprinkler systems including the character and adequacy of water supplies, and the selection of sprinklers, piping, valves, and all materials and accessories. This Committee does not cover the installation of tanks and towers, nor the installation, maintenance, and use of central station, proprietary, auxiliary, and local signaling systems for watchmen, fire alarm, supervisory service, nor the design of fire department hose connections.

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Maurice M. Pilette, *Chair*
Mechanical Designs Ltd., MA [SE]

Kerry M. Bell, UL LLC, IL [RT]
Fred Benn, Advanced Automatic Sprinkler, Inc., CA [IM]
Jonathan C. Bittenbender, REHAU Incorporated, VA [M]
Frederick C. Bradley, FCB Engineering, GA [SE]
Phillip A. Brown, American Fire Sprinkler Association, Inc., TX [IM]
Rep. American Fire Sprinkler Association
Thomas G. Deegan, The Viking Group, Inc., MI [M]
Rep. National Fire Sprinkler Association
Jeffrey Feid, State Farm Insurance Company, IL [I]
Dawn M. Flancher, American Water Works Association, CO [U]
Rep. American Water Works Association
Dana R. Haagensen, Framingham Fire Department, MA [E]
Tonya L. Hoover, CAL FIRE, Office of the State Fire Marshal, CA [E]
Mark Hopkins, Hughes Associates/RJA Group, MD [SE]
Kenneth E. Isman, National Fire Sprinkler Association, Inc., NY [M]
Rep. National Fire Sprinkler Association
Gary L. Johnson, Lubrizol, FL [M]
Charles W. Ketner, National Automatic Sprinkler Fitters LU 669, MD [L]
Rep. United Assn. of Journeymen & Apprentices of the Plumbing & Pipe Fitting Industry
Stephen M. Leyton, Protection Design and Consulting, CA [IM]
Rep. American Fire Sprinkler Association
Ronald G. Nickson, National Multifamily Housing Council, DC [U]
Michael O'Brian, Brighton Area Fire Authority, MI [E]
Rep. International Association of Fire Chiefs
Steven Orlowski, National Association of Home Builders, DC [U]
Milosh T. Puchovsky, Worcester Polytechnic Institute, MA [SE]
Scott C. Pugsley, Classic Fire Protection Inc., Canada [IM]
Rep. Canadian Automatic Sprinkler Association
Peter T. Schwab, Wayne Automatic Fire Sprinklers, Inc., FL [IM]
Eric J. Skare, Uponor, Inc., MN [M]
George W. Stanley, Wiginton Fire Protection Engineering, Inc., FL [IM]
Terry L. Victor, Tyco/SimplexGrinnell, MD [M]
Ed Van Walraven, Aspen Fire Protection District, CO [E]
Ronald N. Webb, S.A. Comunale Company, Inc., OH [IM]
Rep. National Fire Sprinkler Association
Hong-Zeng Yu, FM Global, MA [I]

Alternates

Jon R. Ackley, Dalmatian Fire, Inc., IN [M]
(Alt. to K. E. Isman)
Robert S. Blach, Menlo Park Fire Protection District, CA [E]
(Alt. to M. O'Brian)
Daniel Buuck, National Association of Home Builders, DC [U]
(Alt. to S. Orlowski)
Katherine M. Clay, Jackson Hole Fire/EMS, WY [E]
(Alt. to E. V. Walraven)
Bradford T. Cronin, Newport Fire Department, RI [E]
(Alt. to D. R. Haagensen)
Samuel S. Dannaway, S. S. Dannaway Associates, Inc., HI [SE]
(Voting Alt. to ASPE Rep.)
Bobby A. DiModica, Naples Fire Protection, Inc., FL [IM]
(Alt. to P. T. Schwab)
Mark E. Fessenden, Tyco Fire Protection Products, WI [M]
(Alt. to T. L. Victor)
Jeff Hebenstreit, UL LLC, IL [RT]
(Alt. to K. M. Bell)
Jerry R. Hunter, Aon Fire Protection Engineering Corporation, TX [I]
(Voting Alt. to AON Rep.)
Marshall A. Klein, Marshall A. Klein & Associates, Inc., MD [U]
(Alt. to R. G. Nickson)
Paul McCulloch, Uponor, Inc., MN [M]
(Alt. to E. J. Skare)
Dan Mendoza, Advanced Automatic Sprinkler, CA [IM]
(Alt. to F. Benn)
Angele Morcos, FM Global, MA [I]
(Alt. to H. Yu)
Thomas L. Multer, Reliable Automatic Sprinkler Company, Inc., SC [M]
(Alt. to T. G. Deegan)
David A. Nickelson, REHAU Incorporated, VA [M]
(Alt. to J. C. Bittenbender)
Matthew Osburn, Canadian Automatic Sprinkler Association, Canada [IM]
(Alt. to S. C. Pugsley)
Ernie Paez, CAL FIRE, Office of the State Fire Marshal, CA [E]
(Alt. to T. L. Hoover)
Richard M. Ray, Cybor Fire Protection Company, IL [IM]
(Alt. to R. N. Webb)
Jeffrey E. Reetz, Hughes Associates/RJA Group, MD [SE]
(Alt. to M. Hopkins)
Steven R. Rians, Standard Automatic Fire Enterprises, Inc., TX [IM]
(Alt. to S. M. Leyton)
Ernesto Rodriguez, Jr., Wiginton Fire Protection Engineering, Inc., FL [IM]
(Alt. to G. W. Stanley)
Timothy J. Skinner, National Automatic Sprinkler Fitters LU 669, OH [L]
(Alt. to C. W. Ketner)
Donald R. Townley, Lubrizol, OH [M]
(Alt. to G. L. Johnson)
John F. Viola, South Hadley, MA [IM]
(Alt. to P. A. Brown)

Nonvoting

Rohit Khanna, U.S. Consumer Product Safety Commission, MD [C]

Matthew J. Klaus, NFPA Staff Liaison

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on the design and installation of automatic sprinkler systems in dwellings and residential occupancies up to and including four stories in height, including the character and adequacy of water supplies, and the selection of sprinklers, piping, valves, and all materials and accessories. In addition, this Committee shall have primary responsibility of inspection, testing, and maintenance requirements for sprinkler systems installed in one-and two-family dwellings and manufactured homes.

Contents

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Information on referenced publications can be found in Chapter 2 and Annex B.

Chapter 1 Administration

1.1* Scope. This standard shall cover the design and installation of automatic sprinkler systems for protection against fire hazards in residential occupancies up to and including four stories in height in buildings not exceeding 60 ft (18 m) in height above grade plane.

1.1.1 This standard shall be based on the concept that the sprinkler system is designed to protect against a fire originating from a single ignition location.

1.1.2 This standard shall not provide requirements for the design or installation of water mist fire protection systems, which are not considered fire sprinkler systems and are addressed by NFPA 750.

1.2* Purpose.

1.2.1 The purpose of this standard shall be to provide a sprinkler system that aids in the detection and control of residential fires and thus provides improved protection against injury, life loss, and property damage.

1.2.2 A sprinkler system shall be designed and installed in accordance with this standard to prevent flashover (total involvement) in the room of fire origin, where sprinklered, and to improve the chance for occupants to escape or be evacuated.

1.2.3 The layout, calculation, and installation of sprinkler systems installed in accordance with this standard shall only be performed by people knowledgeable and trained in such systems.

1.3 Retroactivity. The provisions of this standard reflect a consensus of what is necessary to provide an acceptable degree of protection from the hazards addressed in this standard at the time the standard was issued.

1.3.1 Unless otherwise specified, the provisions of this standard shall not apply to facilities, equipment, structures, or installations that existed or were approved for construction or installation prior to the effective date of the standard. Where specified, the provisions of this standard shall be retroactive.

1.3.2 In those cases where the authority having jurisdiction determines that the existing situation presents an unacceptable degree of risk, the authority having jurisdiction shall be permitted to apply retroactively any portions of this standard deemed appropriate.

1.3.3 The retroactive requirements of this standard shall be permitted to be modified if their application clearly would be impractical in the judgment of the authority having jurisdiction, and only where it is clearly evident that a reasonable degree of safety is provided.

1.4 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard.

1.4.1 Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.4.2 The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

1.5 Units.

1.5.1* Metric units of measurement in this standard shall be in accordance with the modernized metric system known as the International System of Units (SI).

1.5.2 The liter and bar units shall be permitted to be used in this standard.

1.5.3 The conversion factors for liter, pascal, and bar shall be in accordance with Table 1.5.3.

Table 1.5.3 Metric Conversions

Name of Unit	Unit Symbol	Conversion Factor
liter	L	1 gal = 3.785 L
pascal	Pa	1 psi = 6894.757 Pa
bar	bar	1 psi = 0.0689 bar
bar	bar	1 bar = 10^5 Pa

1.5.4* Where a value for measurement as specified in this standard is followed by an equivalent value in other units, the first stated value shall be regarded as the requirement.

1.5.5 The equivalent value for a measurement in SI shall be converted by multiplying the value by the conversion factor and then rounding the result to the appropriate number of significant digits.

1.6 New Technology.

1.6.1 Nothing in this standard shall be intended to restrict new technologies or alternate arrangements, provided the level of safety prescribed by this standard is not lowered.

1.6.2 Materials or devices not specifically designated by this standard shall be utilized in complete accord with all conditions, requirements, and limitations of their listings.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 13, *Standard for the Installation of Sprinkler Systems,* 2016 edition.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection,* 2016 edition.

NFPA 22, *Standard for Water Tanks for Private Fire Protection,* 2013 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems,* 2014 edition.

NFPA *101®, Life Safety Code®,* 2015 edition.

NFPA 220, *Standard on Types of Building Construction,* 2015 edition.

NFPA 750, *Standard on Water Mist Fire Protection Systems,* 2014 edition.

NFPA 5000®, *Building Construction and Safety Code®,* 2015 edition.

2.3 Other Publications.

2.3.1 ANSI Publications. American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036.

ANSI B36.10M, *Welded and Seamless Wrought Steel Pipe*, 2004.

2.3.2 ASME Publications. American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016-5990.

ASME A17.1, *Safety Code for Elevators and Escalators*, 2004.

ASME B16.1, *Gray Iron Pipe Flanges and Flanged Fittings, Classes 25, 125, and 250*, 2010.

ASME B16.3, *Malleable Iron Threaded Fittings, Classes 150 and 300*, 2006.

ASME B16.4, *Gray Iron Threaded Fittings, Classes 125 and 250*, 2006.

ASME B16.5, *Pipe Flanges and Flanged Fittings, NPS 1/2 through NPS 24 Metric/Inch Standard*, 2009.

ASME B16.9, *Factory-Made Wrought Buttwelding Fittings*, 2007.

ASME B16.11, *Forged Fittings, Socket-Welding and Threaded*, 2009.

ANSI/ASME B16.15, *Cast Bronze Threaded Fittings*, 2009.

ASME B16.18, *Cast Copper Alloy Solder Joint Pressure Fittings*, 2001.

ASME B16.22, *Wrought Copper and Copper Alloy Solder Joint Pressure Fittings*, 2001.

ASME B16.25, *Buttwelding Ends*, 2007.

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ASTM B32, *Standard Specification for Solder Metal*, 2008.

ASTM B43, *Standard Specification for Seamless Red Brass Pipe*, 2009.

ASTM B88, *Standard Specification for Seamless Copper Water Tube*, 2009.

ASTM B251, *Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube*, 2010.

ASTM B813, *Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper-Alloy Tube*, 2010.

ASTM F437, *Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80*, 2009.

ASTM F438, *Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40*, 2009.

ASTM F439, *Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80*, 2009.

ASTM F442, *Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)*, 2009.

2.3.4 AWS Publications. American Welding Society, 550 NW LeJeune Road, Miami, FL 33126.

AWS A5.8, *Specification for Filler Metals for Brazing and Braze Welding*, 2004.

AWS B2.1, *Specification for Welding Procedure and Performance Qualification*, 2009.

2.3.5 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

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NFPA 5000®, Building Construction and Safety Code®, 2015 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not

defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary,* 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Standard. An NFPA Standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA Manuals of Style. When used in a generic sense, such as in the phrase "standards development process" or "standards development activities," the term "standards" includes all NFPA Standards, including Codes, Standards, Recommended Practices, and Guides.

3.3 General Definitions.

3.3.1* Bathroom. Within a dwelling unit, any room or compartment containing a lavatory dedicated to personal hygiene, or a water closet, or bathing capability such as a shower or tub, or any combination of facilities thereof.

3.3.2 Compartment. A space completely enclosed by walls and a ceiling. Each wall in the compartment is permitted to have openings to an adjoining space if the openings have a minimum lintel depth of 8 in. (203 mm) from the ceiling and the total width of the openings in a single wall does not exceed 8 ft (2.44 m) in width. A single opening of 36 in. (914 mm) or less in width without a lintel is permitted when there are no other openings to adjoining spaces.

3.3.3 Design Discharge. The rate of water discharged by an automatic sprinkler, expressed in gpm (mm/min).

3.3.4 Dwelling Unit. One or more rooms, arranged for the use of one or more individuals living together, as in a single housekeeping unit, that normally have cooking, living, sanitary, and sleeping facilities.

3.3.5 Fuel-Fired Heating Unit. An appliance that produces heat by burning fuel.

3.3.6 Grade Plane. A reference plane upon which vertical measurements of a building are based representing the average of the finished ground level adjoining the building at all exterior walls. *[See also 3.3.222, Finished Ground Level Grade, of NFPA 5000.]* [**5000,** 2015]

3.3.7 Hazard Classifications.

3.3.7.1* *Light Hazard Occupancy.* Occupancies or portions of other occupancies where the quantity and/or combustibility of contents is low and fires with relatively low rates of heat release are expected.

3.3.7.2* *Ordinary Hazard (Group 1).* Occupancies or portions of other occupancies where combustibility is low, quantity of combustibles is moderate, stockpiles of combustibles do not exceed 8 ft (2.4 m), and fires with moderate rates of heat release are expected.

3.3.7.3* *Ordinary Hazard (Group 2).* Occupancies or portions of other occupancies where the quantity and combustibility of contents are moderate to high, stockpiles of contents with moderate rates of heat release do not exceed 12 ft (3.7 m), and stockpiles of contents with high rates of heat release do not exceed 8 ft (2.4 m).

3.3.8* Raw Water Source. A water supply taken from the environment that has not been treated and could contain foreign material that could accumulate freely and enter the sprinkler system.

3.3.9 Residential Occupancies. Occupancies that include the following, as defined in NFPA *101*: (1) apartment buildings, (2) lodging and rooming houses, (3) board and care facilities, and (4) hotels, motels, and dormitories.

3.3.10* Shadow Area. The dry floor area within the protection area of a sprinkler created by the portion of sprinkler discharge that is blocked by a wall or partition.

3.3.11 Sprinkler.

3.3.11.1 *Automatic Sprinkler.* A fire suppression or control device that operates automatically when its heat-actuated element is heated to its thermal rating or above, allowing water to discharge over a specific area.

3.3.11.2 *Quick-Response (QR) Sprinkler.* A type of spray sprinkler having a thermal element with an RTI of 50 $(\text{meters-second})^{1/2}$ or less and is listed as a quick-response sprinkler for its intended use.

3.3.11.3 *Residential Sprinkler.* A type of fast-response sprinkler having a thermal element with an RTI of 50 $(\text{meters-second})^{1/2}$ or less, that has been specifically investigated for its ability to enhance survivability in the room of fire origin, and that is listed for use in the protection of dwelling units.

3.3.12 Sprinkler System. A system that consists of an integrated network of piping designed in accordance with fire protection engineering standards that includes a water supply source, a water control valve, a waterflow alarm, and a drain. The portion of the sprinkler system above ground is a network of specially sized or hydraulically designed piping installed in a building, structure, or area, generally overhead, and to

which sprinklers are attached in a systematic pattern. The system is commonly activated by heat from a fire and discharges water over the fire area. [**13,** 2016]

3.3.12.1 ***Dry Pipe Sprinkler System.*** A sprinkler system employing automatic sprinklers that are attached to a piping system that contains air or nitrogen under pressure, the release of which (as from the opening of a sprinkler) permits the water pressure to open a valve known as a dry pipe valve, and the water then flows into the piping system and out the opened sprinkler.

3.3.12.2 ***Preaction Sprinkler System.*** A sprinkler system employing automatic sprinklers that are attached to a piping system containing air that might or might not be under pressure, with a supplemental detection system installed in the same areas as the sprinklers.

3.3.12.3 ***Wet Pipe Sprinkler System.*** A sprinkler system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by heat from a fire.

3.3.13 System Working Pressure. The maximum anticipated static (nonflowing) or flowing pressure applied to sprinkler system components exclusive of surge pressures.

3.3.14 Valve.

3.3.14.1 ***Check Valve.*** A valve that allows flow in one direction only.

3.3.14.2 ***Control Valve.*** An indicating valve employed to control (shut) a supply of water to a sprinkler system.

3.3.15 Waterflow Alarm. A sounding device activated by a waterflow detector or alarm check valve.

3.3.16 Waterflow Detector. An electric signaling indicator or alarm check valve actuated by water flow in one direction only.

Chapter 4 General Requirements

4.1 Sprinklered Throughout. A building provided with a fire sprinkler system designed and installed in accordance with the requirements of this standard, including its allowable omissions, shall be considered fully sprinklered throughout.

4.2 Basic Requirements. The requirements for spacing, location, and position of sprinklers shall be based on the following principles:

(1) Sprinklers shall be installed throughout the premises.
(2) Sprinklers shall be located so as not to exceed maximum protection area per sprinkler.
(3) Sprinklers shall be positioned and located so as to provide satisfactory performance with respect to activation time and distribution.
(4) Sprinklers shall be permitted to be omitted from areas specifically allowed by this standard *(see Section 6.6)*.
(5) When sprinklers are specifically tested and test results demonstrate that deviations from clearance requirements to structural members do not impair the ability of the sprinkler to control or suppress a fire, their positioning and locating in accordance with the test results shall be permitted.
(6) Clearance between sprinklers and ceilings exceeding the maximums specified in this standard shall be permitted, provided that tests or calculations demonstrate comparable sensitivity and performance of the sprinklers to those installed in conformance with these sections.

4.3 Tube. Wherever the word *pipe* is used in this standard, it shall also mean *tube*.

4.4 Listed or Labeled. Listed or labeled devices and materials shall be installed and used in accordance with the listing limitations and the manufacturers' instructions unless permitted by other sections of this document.

4.5 System Arrangement. In townhouse-style buildings protected in accordance with this standard, each dwelling unit shall have its own dedicated sprinkler system or the control valve for the sprinkler system in the building shall be located outside the dwelling units or in a common area.

Chapter 5 System Components

5.1 General.

5.1.1 Sprinklers.

5.1.1.1* Sprinkler Removal. Only new listed sprinklers shall be installed in sprinkler systems.

5.1.1.1.1* Where a sprinkler is removed from a fitting or welded outlet, it shall not be reinstalled except as permitted by 5.1.1.1.1.1.

5.1.1.1.1.1 Dry sprinklers shall be permitted to be reinstalled when removed in accordance with the manufacturer's installation and maintenance instructions.

5.1.1.2* Sprinkler Replacement. Where replacing residential sprinklers manufactured prior to 2003 and that are no longer available from the manufacturer and are installed using a design density less than 0.05 gpm/ft^2 (204 mm/min), a residential sprinkler with an equivalent K-factor (± 5%) shall be permitted to be used provided the currently listed coverage area for the replacement sprinkler is not exceeded.

5.1.1.3* Sprinkler Identification. All sprinklers shall be permanently marked with a one- or two-character manufacturer symbol, followed by three or four numbers, so as to identify a unique sprinkler identification for every change in orifice size or shape, deflector characteristic, pressure rating, and thermal sensitivity.

5.1.1.4 Sprinkler Discharge Characteristics.

5.1.1.4.1 General. Unless the requirements of 5.1.1.4.2 or 5.1.1.4.3 are met, the K-factor, relative discharge, and marking identification for sprinklers having different orifice sizes shall be in accordance with Table 5.1.1.4.1.

5.1.1.4.2 Pipe Threads. Listed sprinklers having pipe threads different from those shown in Table 5.1.1.4.1 shall be permitted.

5.1.1.4.3 Residential Sprinklers. Residential sprinklers with K-factors other than those specified in Table 5.1.1.4.1 shall be permitted.

5.1.1.5 Occupancy Limitations. Unless the requirements of 5.1.1.5.1 or 5.1.1.5.2 are met, sprinklers shall not be listed for protection of a portion of an occupancy classification.

5.1.1.5.1 Residential Sprinklers. Residential sprinklers shall be permitted to be listed for portions of residential occupancies.

Table 5.1.1.4.1 Sprinkler Discharge Characteristics Identification

Nominal K-factor [gpm/(psi)$^{1/2}$]	K-factor Range [gpm/(psi)$^{1/2}$]	K-factor Range [dm^3/min/(kPa)$^{1/2}$]	Percent of Nominal K-5.6 Discharge	Thread Type (in. NPT)
1.4	1.3–1.5	1.9–2.2	25	½
1.9	1.8–2.0	2.6–2.9	33.3	½
2.8	2.6–2.9	3.8–4.2	50	½
4.2	4.0–4.4	5.9–6.4	75	½
5.6	5.3–5.8	7.6–8.4	100	½
8.0	7.4–8.2	10.7–11.8	140	¾ or ½
11.2	11.0–11.5	15.9–16.6	200	½ or ¾
14.0	13.5–14.5	19.5–20.9	250	¾
16.8	16.0–17.6	23.1–25.4	300	¾
19.6	18.6–20.6	27.2–30.1	350	1
22.4	21.3–23.5	31.1–34.3	400	1
25.2	23.9–26.5	34.9–38.7	450	1
28.0	26.6–29.4	38.9–43.0	500	1

5.1.1.5.2 Special Sprinklers. Special sprinklers shall be permitted to be listed for protection of a specific construction feature in a portion of an occupancy classification where such sprinklers meet 5.1.1.5.3 and have been evaluated and listed for performance under the following conditions:

(1) Fire tests related to the intended hazard
(2) Distribution of the spray pattern with respect to wetting of floors and walls
(3) Distribution of the spray pattern with respect to obstructions
(4) Evaluation of the thermal sensitivity of the sprinkler
(5) Performance under horizontal or sloped ceilings
(6) Area of design

5.1.1.5.3 Special sprinklers shall maintain the following characteristics:

(1) Orifice size shall be in accordance with 5.1.1.4.
(2) Temperature ratings shall be in accordance with Table 5.1.1.6.1.
(3) The protection area of coverage shall not exceed 400 ft^2 (37 m^2) for light hazard and ordinary hazard occupancies.

5.1.1.6* Temperature Characteristics.

5.1.1.6.1 Automatic sprinklers shall have their frame arms, deflector, coating material, or liquid bulb colored in accordance with the requirements of Table 5.1.1.6.1 or the requirements of 5.1.1.6.2, 5.1.1.6.3, 5.1.1.6.4, or 5.1.1.6.5.

5.1.1.6.2 A dot on the top of the deflector, the color of the coating material, or colored frame arms shall be permitted for color identification of corrosion-resistant sprinklers.

5.1.1.6.3 Color identification shall not be required for ornamental sprinklers such as factory-plated or factory-painted sprinklers or for recessed, flush, or concealed sprinklers.

5.1.1.6.4 The frame arms of bulb-type sprinklers shall not be required to be color coded.

5.1.1.6.5 The liquid in bulb-type sprinklers shall be color coded in accordance with Table 5.1.1.6.1.

5.1.1.7 Escutcheons and Cover Plates.

5.1.1.7.1 Nonmetallic escutcheons shall be listed.

5.1.1.7.2* Escutcheons used with recessed, flush-type, or concealed sprinklers shall be part of a listed sprinkler assembly.

5.1.1.7.3 Cover plates used with concealed sprinklers shall be part of the listed sprinkler assembly.

5.1.1.8 Painting and Finish. Sprinkler painting and finish material shall only be permitted in accordance with NFPA 13.

5.1.1.9 Protective Caps and Straps.

5.1.1.9.1* Protective caps and straps shall be removed using means that are in accordance with the manufacturer's instructions.

5.1.1.9.2* Protective caps and straps shall be removed from all sprinklers prior to the time when the sprinkler system is placed in service.

5.1.1.9.3 Protective caps and straps on all upright sprinklers or on any sprinklers installed more than 10 ft (3 m) above the floor shall be permitted to be removed from sprinklers immediately following their installation.

5.1.2 Listing. Only listed or approved devices and materials as specified in this standard shall be used in sprinkler systems.

5.1.2.1 Water meters and pressure-reducing valves that are installed in a combined domestic water and fire protection supply to the building shall not be required to be listed for fire protection.

5.1.2.2 Materials and components shall be installed in accordance with material compatibility information that is available as a part of a listing or manufacturer's published information.

5.1.3 Rated Pressure. System components shall be rated for the maximum system working pressure to which they are exposed but shall not be rated at less than 175 psi (12.1 bar) for

Table 5.1.1.6.1 Sprinkler Temperature Ratings, Classifications, and Color Codings

Maximum Ceiling Temperature		Temperature Rating		Temperature Classification	Color Code	Glass Bulb Colors
°F	°C	°F	°C			
100	38	135–170	57–77	Ordinary	Uncolored or black	Orange or red
150	66	175–225	79–107	Intermediate	White	Yellow or green
225	107	250–300	121–149	High	Blue	Blue
300	149	325–375	163–191	Extra high	Red	Purple
375	191	400–475	204–246	Very extra high	Green	Black
475	246	500–575	260–302	Ultra high	Orange	Black
625	329	650	343	Ultra high	Orange	Black

components installed above ground and 150 psi (10.4 bar) for components installed underground between the water supply and the system riser.

5.1.4 Reconditioned Equipment.

5.1.4.1 The use of reconditioned valves and devices as replacement equipment in existing systems shall be permitted.

5.1.4.2 Reconditioned sprinklers shall not be permitted to be utilized on any new or existing system.

5.2 Aboveground Piping and Equipment.

5.2.1 Pipe or tube used in sprinkler systems shall be of the materials specified in Table 5.2.1 or in accordance with 5.2.2.

5.2.1.1 The chemical properties, physical properties, and dimensions of pipe materials shall be at least equivalent to the standards cited in Table 5.2.1.

5.2.1.2 Pipe shall be designed to withstand a working pressure of not less than 175 psi (12.1 bar).

5.2.1.3 When nonmetallic pipe is used, the pipe shall be designed to withstand a working pressure of not less than 175 psi (12.1 bar) at 120°F (49°C).

5.2.1.4 Nonmetallic pipe and fittings included in Table 5.2.1 and Table 5.2.9 shall be listed.

5.2.2 Types of pipe other than those specified in Table 5.2.1 shall be permitted to be used where listed for sprinkler system use.

5.2.2.1 Pipe differing from those specified in Table 5.2.1 shall be installed in accordance with their listings and the manufacturer's installation instructions.

5.2.2.2 Pipe or tube listed for light hazard occupancies shall be permitted to be installed in ordinary hazard rooms of otherwise light hazard occupancies where the room does not exceed 400 ft^2 (37 m^2).

5.2.3* Chlorinated polyvinyl chloride (CPVC) pipe shall comply with the portions of the American Society for Testing and Materials (ASTM) standards specified in Table 5.2.1 that apply to fire protection service

5.2.3.1 Nonmetallic pipe in accordance with Table 5.2.1 shall be investigated for suitability in automatic sprinkler installations and listed for this service.

Table 5.2.1 Pipe or Tube Materials and Dimensions

Materials and Dimensions	Standard
Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use	ASTM A795
Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless	ASTM A53
Welded and Seamless Wrought Steel Pipe	ANSI B36.10M
Standard Specification for Electric-Resistance-Welded Steel Pipe	ASTM A135
Standard Specification for Seamless Copper Water Tube [Copper Tube (Drawn, Seamless)]	ASTM B88
Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube	ASTM B251
Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper-Alloy Tube	ASTM B813
Specification for Filler Metals for Brazing and Braze Welding (Classification BCuP-3 or BCuP-4)	AWS A5.8
Standard Specification for Solder Metal Section 1: Solder Alloys Containing Less than 0.2 percent lead (Pb) as identified in ASTM B32, Table 5, Section 1, and having a solidus temperature that exceeds 400°F (204°C)	ASTM B32
Cast Bronze Threaded Fittings	ASME B16.15
Standard Specification for Seamless Red Brass Pipe	ASTM B43
Nonmetallic Piping Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)	ASTM F442

5.2.3.1.1 Listed nonmetallic pipe shall be installed in accordance with its listing limitations, including installation instructions.

5.2.3.1.2 Manufacturer's installation instructions shall include its listing limitations.

5.2.3.2 When nonmetallic pipe is used in systems utilizing steel pipe internally coated with corrosion inhibitors, the steel pipe coating shall be listed for compatibility with the nonmetallic pipe materials.

5.2.3.3 When nonmetallic pipe is used in systems utilizing steel pipe that is not internally coated with corrosion inhibitors, no additional evaluations shall be required.

5.2.3.4* When nonmetallic pipe is used in systems utilizing steel pipe, cutting oils and lubricants used for fabrication of the steel piping shall be compatible with the nonmetallic pipe materials in accordance with 5.1.2.2.

5.2.3.5 Fire-stopping materials intended for use on nonmetallic piping penetrations shall be compatible with the nonmetallic pipe materials in accordance with 5.1.2.2.

5.2.3.6 Nonmetallic pipe listed for light hazard occupancies shall be permitted to be installed in ordinary hazard rooms of otherwise light hazard occupancies where the room does not exceed 400 ft^2 (37 m^2).

5.2.3.7 Nonmetallic pipe shall not be listed for portions of an occupancy classification.

5.2.4 Brass pipe specified in Table 5.2.1 shall be permitted in the standard weight in sizes up to 6 in. (150 mm) for pressures up to 175 psi (12.1 bar) and in the extra strong weight in sizes up to 8 in (200 mm). for pressures up to 300 psi (20.7 bar).

5.2.5 Pipe with a wall thickness less than that of Schedule 30 pipe shall not be joined by fittings utilizing cut grooves where the pipe is 8 in. (203 mm) nominal or larger in size.

5.2.6 Pipe having a wall thickness less than that of Schedule 40 pipe shall not be joined by fittings utilizing cut grooves where the pipe is less than 8 in. (203 mm) nominal in size.

5.2.7 Pipe joined with mechanical fittings using cut or rolled grooves shall be joined by a listed combination of fittings, gaskets, and grooves.

5.2.8 Grooves cut or rolled on pipe shall be dimensionally compatible with the fittings.

5.2.9 Fittings used in sprinkler systems shall meet or exceed the standards in Table 5.2.9 or be in accordance with 5.2.12.

5.2.9.1 The chemical properties, physical properties, and dimensions of fitting materials shall be at least equivalent to the standards cited in Table 5.2.9.

5.2.9.2 Fittings used in sprinkler systems shall be designed to withstand a working pressure of not less than 175 psi (12.1 bar).

5.2.9.3 When nonmetallic fittings are used, the fittings shall be designed to withstand a working pressure of not less than 175 psi (12.1 bar) at 120°F (49°C).

5.2.10 Joints for the connection of copper pipe shall be brazed on dry pipe and preaction systems.

5.2.11 Joints for the connection of copper pipe for wet systems shall use solder joints with 95-5 solder metal or be brazed.

5.2.12 Types of fittings other than those specified in Table 5.2.9 shall be permitted to be used where listed for sprinkler system use.

5.2.12.1 Fittings differing from those specified in Table 5.2.9 shall be installed in accordance with their listings and the manufacturer's installation instructions.

Table 5.2.9 Fittings Materials and Dimensions

Materials and Dimensions	Standard
Cast Iron	
Gray Iron Threaded Fittings (Class 125 and 250)	ASME B16.4
Gray Iron Pipe Flanges and Flanged Fittings	ASME B16.1
Malleable Iron	
Malleable Iron Threaded Fittings	ASME B16.3
Steel	
Factory-Made Wrought Buttwelding Fittings	ASME B16.9
Buttwelding Ends	ASME B16.25
Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperatures	ASTM A234
Pipe Flanges and Flanged Fittings (Nickel Alloy and Other Special Alloys)	ASME B16.5
Forged Fittings, Socket-Welding and Threaded	ASME B16.11
Copper	
Wrought Copper and Copper Alloy Solder Joint Pressure Fittings	ASME B16.22
Cast Copper Alloy Solder Joint Pressure Fittings	ASME B16.18
CPVC	
Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80	ASTM F437
Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40	ASTM F438
Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80	ASTM F439

5.2.12.2* Nonmetallic fittings shall comply with the portions of the ASTM standards specified in Table 5.2.9 that apply to fire protection service.

5.2.12.2.1 Nonmetallic fittings in accordance with Table 5.2.9 shall be investigated for suitability in automatic sprinkler installations and listed for this service. Listed nonmetallic fittings shall be installed in accordance with their listing limitations, including installation instructions.

5.2.12.2.1.1 When nonmetallic fittings are used in systems utilizing internally coated steel piping, the steel pipe coating shall be listed for compatibility with the nonmetallic fittings.

5.2.12.2.1.2 When nonmetallic fittings are used in systems utilizing steel pipe that is not internally coated with corrosion inhibitors, no additional evaluations shall be required.

5.2.12.2.1.3* When nonmetallic fittings are used in systems utilizing steel pipe, cutting oils and lubricants used for fabrication of the steel piping shall be compatible with the nonmetallic fittings in accordance with 5.1.2.2.

5.2.12.2.1.4 Fire-stopping materials intended for use on nonmetallic fitting penetrations shall be investigated for compatibility with the nonmetallic fitting materials in accordance with 5.1.2.2.

5.2.12.2.1.5* Other types of fittings investigated for suitability in automatic sprinkler installations and listed for this service, including but not limited to CPVC and steel, and differing from that provided in Table 5.2.9 shall be permitted when installed in accordance with their listing limitations, including installation instructions.

5.2.13 Welded pipe and fittings shall be permitted to be used in accordance with the rules of NFPA 13.

5.2.14 Valves.

5.2.14.1 General.

5.2.14.1.1 Valve Pressure Requirements. When water pressures exceed 175 psi (12.1 bar), valves shall be used in accordance with their pressure ratings.

5.2.14.1.2 Valve Closure Time. Unless the requirements of 6.8.5 apply, listed indicating valves shall not close in less than 5 seconds when operated at maximum possible speed from the fully open position.

5.2.14.1.3 Listed Indicating Valves. Unless the requirements of 5.2.14.1.3.1, 5.2.14.1.3.2, or 5.2.14.1.3.3 are met, all valves controlling connections to water supplies and to supply pipes to sprinklers shall be listed indicating valves.

5.2.14.1.3.1 A listed underground gate valve equipped with a listed indicator post shall be permitted.

5.2.14.1.3.2 A listed water control valve assembly with a reliable position indication connected to a remote supervisory station shall be permitted.

5.2.14.1.3.3 A nonindicating valve, such as an underground gate valve with approved roadway box, complete with T-wrench, and where accepted by the authority having jurisdiction, shall be permitted.

5.2.14.2 Wafer-Type Valves. Wafer-type valves with components that extend beyond the valve body shall be installed in a manner that does not interfere with the operation of any system components.

5.2.14.3 Drain Valves and Test Valves. Drain valves and test valves shall be approved.

5.2.14.4* Identification of Valves.

5.2.14.4.1 All control, drain, and test connection valves shall be provided with permanently marked weatherproof metal or rigid plastic identification signs.

5.2.14.4.2 The identification sign shall be secured with corrosion-resistant wire, chain, or other approved means.

5.2.14.4.3 The control valve sign shall identify the portion of the building served.

5.2.14.4.4* Systems that have more than one control valve that must be closed to work on a system or space shall have a sign referring to the existence and location of other valves.

5.2.14.5 Backflow Preventers.

5.2.14.5.1* Backflow preventers shall be listed for fire protection service.

5.2.15 Gauges.

5.2.15.1 A pressure gauge with a connection not smaller than ¼ in. (6.4 mm) shall be installed at the system main drain, at each main drain associated with a floor control valve, and on the inlet and outlet side of each pressure-reducing valve.

5.2.15.2 Each gauge connection shall be equipped with a shutoff valve and provisions for draining.

5.2.15.3 The required pressure gauges shall be approved and shall have a maximum limit not less than twice the normal system working pressure at the point where installed.

5.2.15.4 Gauges shall be installed to permit removal and shall be located where they will not be subject to freezing.

5.3* Underground Pipe. Any type of pipe or tube acceptable under the plumbing code for underground supply pipe shall be acceptable as underground supply for the system when installed between the point of connection and the system riser.

5.4 System Types.

5.4.1 A wet pipe system shall be used where piping is installed in areas that can be maintained reliably above 40°F (4°C).

5.4.2* Piping in areas that cannot be maintained reliably above 40°F (4°C) shall be protected by use of one of the following methods:

(1) *Antifreeze system using a listed antifreeze solution in accordance with NFPA 13
(2) Dry pipe system
(3) Preaction system
(4) Listed dry pendent, dry upright, or dry sidewall sprinklers extended from pipe in heated areas
(5) Heat tracing in accordance with 6.7.2.2

5.4.3 Where antifreeze systems, dry pipe systems, and preaction systems are installed, they shall be installed in accordance with NFPA 13.

5.4.4 Water-filled piping shall be permitted to be installed in areas where the temperature is less than 40°F (4°C) when heat loss calculations performed by a professional engineer verify that the system will not freeze.

Chapter 6 Installation

6.1 System Protection Area Limitations.

6.1.1 The maximum floor area on any one floor to be protected by sprinklers supplied by any one sprinkler system riser or combined system riser shall not exceed 52,000 ft^2 (4831 m^2).

6.1.2 The floor area occupied by mezzanines shall not be included in the area limits of 6.1.1.

6.2 Use of Sprinklers.

6.2.1 Inside Dwelling Units.

6.2.1.1 Listed residential sprinklers shall be used unless another type is permitted by 6.2.1.3 or 6.2.1.4.

6.2.1.2 Residential sprinklers shall not be used on systems other than wet pipe systems unless specifically listed for use on that particular type of system.

6.2.1.3 Listed quick-response sprinklers shall be permitted to be installed in dwelling units meeting the definition of a compartment, as defined in Section 3.3, where no more than four sprinklers are located in the dwelling unit.

6.2.1.3.1 Where quick-response sprinklers, including extended coverage quick-response sprinklers, are used, the density/area requirement shall be a minimum of 0.1 gpm/ft^2 (4.1 mm/min) over the entire dwelling unit.

6.2.1.3.2 Where extended coverage quick-response sprinklers are used, the flow shall be sufficient to meet the listing of the sprinklers at the spacing for which they are being used.

6.2.1.4 Quick-response sprinklers discharging a minimum of 0.1 gpm/ft^2 (4.1 mm/min) shall be permitted to be used in mechanical closets.

6.2.2 Outside Dwelling Units.

6.2.2.1 Sprinklers outside of the dwelling units shall be quick response, except as permitted by 6.2.2.2.

6.2.2.1.1 The sprinkler design criteria shall be in accordance with Chapter 7.

6.2.2.2 The following types of spaces shall be permitted to be protected by residential sprinklers in accordance with Section 7.1:

(1) Lobbies not in hotels and motels
(2) Foyers
(3) Corridors
(4) Halls
(5) Lounges
(6) Ordinary hazard areas in accordance with 7.2.4.1
(7) Garages in accordance in accordance with 7.3.3 and 7.3.3.1(1)
(8) Other areas with fire loads similar to residential fire loads

6.2.3 Temperature Ratings.

6.2.3.1* Sprinklers installed where maximum ambient ceiling temperatures do not exceed 100°F (38°C) shall be ordinary temperature–rated sprinklers or intermediate temperature–rated unless modified by 6.2.3.3.

6.2.3.2* Sprinklers installed where maximum ambient ceiling temperatures are between 101°F and 150°F (39°C and 66°C) shall be intermediate temperature–rated sprinklers unless modified by 6.2.3.3.

6.2.3.3* The practices of 6.2.3.3.1 through 6.2.3.3.3 shall be observed when installing residential sprinklers unless higher expected ambient temperatures require a higher temperature rating.

6.2.3.3.1 Sprinklers under glass or plastic skylights exposed to direct rays of the sun shall be of intermediate temperature classification.

6.2.3.3.2 Sprinklers in an unventilated concealed space under uninsulated roof or in an unventilated attic shall be of intermediate temperature classification.

6.2.3.3.3 Sprinklers installed near specific heat sources that are identified in Table 6.2.3.3.3 shall be of the temperature rating indicated in Table 6.2.3.3.3 unless sprinklers are listed for positioning closer to the heat source.

6.2.3.4 All sprinklers within a compartment shall have the same temperature classification except where required by 6.2.3.3 for a specific location.

Table 6.2.3.3.3 Minimum Distances for Ordinary and Intermediate Temperature Residential Sprinklers

	From Edge of Source to Ordinary Temperature Sprinkler		From Edge of Source to Intermediate Temperature Sprinkler	
Heat Source	**in.**	**mm**	**in.**	**mm**
Side of open or recessed fireplace	36	900	12	300
Front of recessed fireplace	60	1500	36	900
Coal- or wood-burning stove	42	1050	12	300
Kitchen range	18	450	9	225
Wall oven	18	450	9	225
Hot air flues	18	450	9	225
Uninsulated heat ducts	18	450	9	225
Uninsulated hot water pipes	12	300	6	150
Side of ceiling- or wall-mounted hot air diffusers	24	600	12	300
Front of wall-mounted hot air diffusers	36	900	18	450
Hot water heater or furnace	6	150	3	75
Light fixture:				
0 W–250 W	6	150	3	75
250 W–499 W	12	300	6	150

6.2.3.5 Sprinkler Positioning.

6.2.3.5.1 Sprinklers shall be positioned in accordance with this standard and the manufacturer's installation guidelines.

6.2.3.5.2 Ceiling Pockets.

6.2.3.5.2.1 Sprinklers shall be required in all ceiling pockets.

6.2.3.5.2.2 The requirement of 6.2.3.5.2.1 shall not apply where all of the following requirements are met:

(1) The total volume of the unprotected ceiling pocket does not exceed 100 ft^3 (2.83 m^3).
(2) The depth of the unprotected ceiling pocket does not exceed 12 in. (305 mm).
(3) The entire floor of the unprotected ceiling pocket is protected by the sprinklers at the lower ceiling elevation.
(4) The interior finish of the unprotected ceiling pocket is noncombustible or limited-combustible construction.

6.2.4 Exposed Barrel Lengths.

6.2.4.1* Where dry sprinklers are connected to wet pipe sprinkler systems protecting areas subject to freezing temperatures, the minimum exposed length of the barrel of the dry sprinkler shall be in accordance with Table 6.2.4.1(a) or Table 6.2.4.1(b).

6.2.4.2 The minimum barrel length shall be measured from the face of the fitting to which the dry sprinkler is installed to the inside surface of the insulation, wall, or ceiling leading to the cold space, whichever is closer to the fitting.

Table 6.2.4.1(a) Minimum Exposed Barrel Lengths for Dry Sprinklers (U.S. Customary Units)

Ambient Temperature Exposed to Discharge End of Sprinkler (°F)	Minimum Exposed Barrel Length		
	When Exposed to 40°F (in.)	When Exposed to 50°F (in.)	When Exposed to 60°F (in.)
40	0	0	0
30	0	0	0
20	4	0	0
10	8	1	0
0	12	3	0
–10	14	4	1
–20	14	6	3
–30	16	8	4
–40	18	8	4
–50	20	10	6
–60	20	10	6

Table 6.2.4.1(b) Minimum Exposed Barrel Lengths for Dry Sprinklers (Metric Units)

Ambient Temperature Exposed to Discharge End of Sprinkler (°C)	Minimum Exposed Barrel Length		
	When Exposed to 4.4°C (mm)	When Exposed to 10°C (mm)	When Exposed to 15.6°C (mm)
4	0	0	0
–1	0	0	0
–7	100	0	0
–12	200	25	0
–18	300	75	0
–23	360	100	25
–29	360	150	75
–34	400	200	100
–40	460	200	100
–46	510	250	150
–51	510	250	150

6.3 Quick-Response Sprinklers. Where quick-response sprinklers are installed in accordance with 6.2.1.3, 6.2.1.4, or 6.2.2.1, the maximum allowable spacing, minimum allowable spacing, obstruction criteria, and distance from the ceiling shall be in accordance with NFPA 13.

6.4 Residential Sprinklers.

6.4.1 Residential Sprinklers That Have Been Listed with Specific Coverage Criteria. Sprinklers shall be installed in accordance with the coverage criteria specified by the listing.

6.4.2 Sloped Ceilings.

6.4.2.1 Where the ceiling is sloped, the maximum *S* dimension shall be measured along the slope of the ceiling to the next sprinkler as shown in Figure 6.4.2.1.

6.4.2.2 The sprinklers shall maintain the minimum listed spacing, but not less than 8 ft (2.44 m), measured in the plan view from one sprinkler to another as shown in Figure 6.4.2.1.

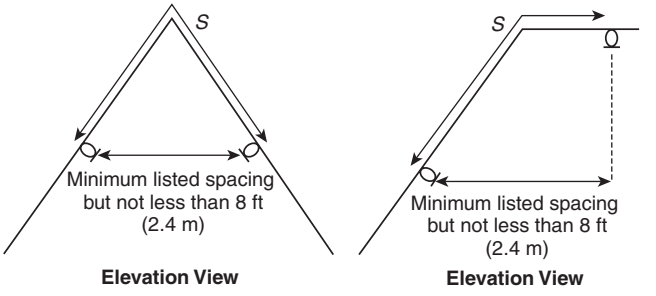

FIGURE 6.4.2.1 Measuring *S* Dimension.

6.4.3 Sprinklers shall be installed in accordance with their listing where the type of ceiling configuration is referenced in the listing.

6.4.4* Where construction features or other special conditions exist that are outside the scope of sprinkler listings, listed sprinklers shall be permitted to be installed beyond their listing limitations.

6.4.5 Operating Pressure. The minimum operating pressure of any sprinkler shall be the higher of the minimum operating pressure specified by the listing or 7 psi (0.5 bar).

6.4.6 Position of Residential Sprinklers.

6.4.6.1 Pendent and Upright Sprinklers.

6.4.6.1.1 Pendent and upright sprinklers that have not been listed with specific positioning criteria shall be positioned so that the deflectors are within 1 in. to 4 in. (25.4 mm to 102 mm) of the ceiling.

6.4.6.1.2 Pendent and upright sprinklers that have been listed with specific positioning criteria shall be positioned in accordance with the listing.

6.4.6.1.3 Except as permitted by 6.4.6.3.2, pendent and upright sprinklers shall be located a minimum of 4 in. (102 mm) from a wall.

6.4.6.2 Sidewall Sprinklers.

6.4.6.2.1 Sidewall sprinklers that have not been listed with specific positioning criteria shall be positioned so that the deflectors are within 4 in. to 6 in. (102 mm to 152 mm) of the ceiling.

6.4.6.2.2 Sidewall sprinklers that have been listed with specific positioning criteria shall be positioned in accordance with the listing.

6.4.6.2.3 Residential horizontal sidewall sprinkler deflectors shall be located no more than 6 in. (152 mm) from the wall on which they are mounted.

6.4.6.3* Obstructions to Residential Sprinklers.

6.4.6.3.1* Except as otherwise permitted in 6.4.6.3, residential sprinklers shall provide complete coverage of the floor area within the compartments requiring sprinkler protection.

6.4.6.3.2* Within Closets. In all closets and compartments that are enclosed by walls and a door and that are not larger than 400 ft^3 (11.33 m^3), including those housing mechanical equipment, pendent, upright and sidewall residential sprinklers shall be permitted to be installed in either of the following situations:

(1) Within 18 in. (460 mm) of the ceiling to avoid obstructions near the ceiling
(2) At the highest ceiling level without regard to obstructions or minimum distances to wall

6.4.6.3.3 Other than Closets.

6.4.6.3.3.1* Shadow Areas. Shadow areas shall be permitted in the protection area of a sprinkler as long as the cumulative dry areas do not exceed 15 ft^2 (1.4 m^2) per sprinkler.

6.4.6.3.3.2 Shadow areas in corridors up to 2 ft (0.61 m) in depth and up to 9 ft (2.7 m) in length behind sidewall sprinklers shall be permitted as shown in Figure 6.4.6.3.3.2.

6.4.6.3.3.3 Small areas created by architectural features such as planter box windows, bay windows, and similar features shall be evaluated as follows:

(1) Where no additional floor area is created by the architectural feature, no additional sprinkler protection is required.
(2) Where additional floor area is created by an architectural feature, no additional sprinkler protection is required, provided all of the following conditions are met:
   (a) The floor area shall not exceed 18 ft^2 (1.7 m^2).
   (b) The floor area shall not be greater than 2 ft (0.61 m) in depth at the deepest point of the architectural feature to the plane of the primary wall where measured along the finished floor.
   (c) The floor shall not be greater than 9 ft (2.7 m) in length where measured along the plane of the primary wall.
   (d) Measurement from the deepest point of the architectural feature to the sprinkler shall not exceed the maximum listed spacing of the sprinkler.
(3) The hydraulic design is not required to consider the area created by the architectural feature.

6.4.6.3.4 Pendent Sprinklers.

6.4.6.3.4.1 Pendent sprinklers shall be located at least 3 ft (914 mm) from obstructions such as ceiling fans and light fixtures unless the requirements of 6.4.6.3.6 are met.

6.4.6.3.4.2 The distance shall be measured from the center of the sprinkler to the center of the obstruction.

6.4.6.3.4.3 Where the sprinkler cannot be located 3 ft (914 mm) from the obstruction (as measured from the center of the obstruction), an additional sprinkler shall be located on the other side of the obstruction.

6.4.6.3.4.4 Where the area of the fan blades encompasses more than 50 percent of the area of the plan view, the sprinkler shall be installed in accordance with 6.4.6.3.6.

6.4.6.3.5 Sidewall Sprinklers.

6.4.6.3.5.1 Sidewall sprinklers shall be located at least 5 ft (1.52 m) from obstructions such as ceiling fans and light fixtures unless the requirements of 6.4.6.3.7 are met.

6.4.6.3.5.2 The distance shall be measured from the center of the sprinkler to the center of the obstruction.

6.4.6.3.5.3 Where the sprinkler cannot be located 5 ft (1.52 m) from the obstruction (as measured to the center of the obstruction), an additional sprinkler shall be installed on the other side of the obstruction.

6.4.6.3.5.4 Where the area of the fan blades encompasses more than 50 percent of the area of the plan view, the sprinkler shall be installed in accordance with 6.4.6.3.6.

6.4.6.3.6 Continuous Obstructions to Pendent Sprinklers.

6.4.6.3.6.1 Sprinklers shall be positioned with respect to continuous obstructions in accordance with 6.4.6.3.6.2, 6.4.6.3.6.3, or 6.4.6.3.6.4.

6.4.6.3.6.2 Sprinklers shall be positioned with respect to continuous obstructions in accordance with Table 6.4.6.3.6.2 and Figure 6.4.6.3.6.2.

6.4.6.3.6.3 Sprinklers shall be positioned with respect to an obstruction against a wall in accordance with Figure 6.4.6.3.6.3(a) or Figure 6.4.6.3.6.3(b).

6.4.6.3.6.4 A sprinkler shall be installed on the other side of the obstruction.

6.4.6.3.7 Continuous Obstructions to Sidewall Sprinklers.

6.4.6.3.7.1 Sprinklers shall be positioned with respect to continuous obstructions in accordance with 6.4.6.3.7.2 or 6.4.6.3.7.3.

6.4.6.3.7.2 Sprinklers shall be positioned with respect to continuous obstructions in accordance with Table 6.4.6.3.7.2(a), Figure 6.4.6.3.7.2(a), Table 6.4.6.3.7.2(b), Figure 6.4.6.3.7.2(b), and Figure 6.4.6.3.7.2(c).

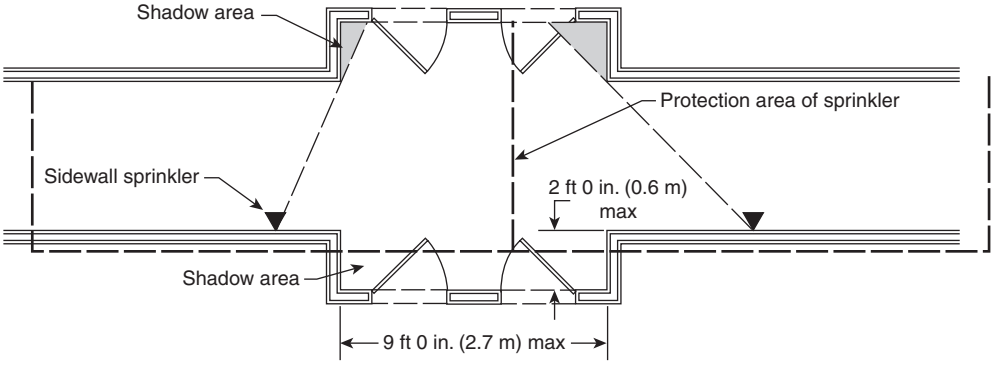

FIGURE 6.4.6.3.3.2 Shadow Areas Behind Sidewall Sprinklers in Corridors.

Table 6.4.6.3.6.2 Positioning of Sprinklers to Avoid Obstructions to Discharge (Residential Upright and Pendent Spray Sprinklers)

Distance from Sprinklers to Side of Obstruction (*A*)	Maximum Allowable Distance of Deflector Above Bottom of Obstruction (in.) (*B*)
Less than 1 ft (0.30 m [300 mm])	0
1 ft (0.30 m [300 mm]) to less than 1 ft 6 in. (0.45 m [450 mm])	0
1 ft 6 in. (0.45 m [450 mm]) to less than 2 ft (0.6 m [600 mm])	1 (25 mm)
2 ft (0.6 m [600 mm]) to less than 2 ft 6 in. (0.75 m [750 mm])	1 (25 mm)
2 ft 6 in. (0.75 m [750 mm]) to less than 3 ft (0.9 m [900 mm])	1 (25 mm)
3 ft (0.9 m [900 mm]) to less than 3 ft 6 in. (1.05 m [1050 mm])	3 (75 mm)
3 ft 6 in. (1.05 m [1050 mm]) to less than 4 ft (1.2 m [1200 mm])	3 (75 mm)
4 ft (1.2 m [1200 mm]) to less than 4 ft 6 in. (1.35 m [1350 mm])	5 (125 mm)
4 ft 6 in. (1.35 m [1350 mm]) to less than 5 ft (1.5 m [1500 mm])	7 (175 mm)
5 ft (1.5 m [1500 mm]) to less than 5 ft 6 in. (1.65 m [1650 mm])	7 (175 mm)
5 ft 6 in. (1.65 m [1650 mm]) to less than 6 ft (1.8 m [1800 mm])	7 (175 mm)
6 ft (1.8 m [1800 mm]) to less than 6 ft 6 in. (1.95 m [1950 mm])	9 (225 mm)
6 ft 6 in. (1.95 m [1950 mm]) to less than 7 ft (2.1 m [2100 mm])	11 (275 mm)
7 ft (2.1 m [2100 mm]) and greater	14 (350 mm)

For SI units, 1 in. = 25 mm; 1 ft = 0.30 m.
Note: For *A* and *B*, refer to Figure 6.4.6.3.6.2.

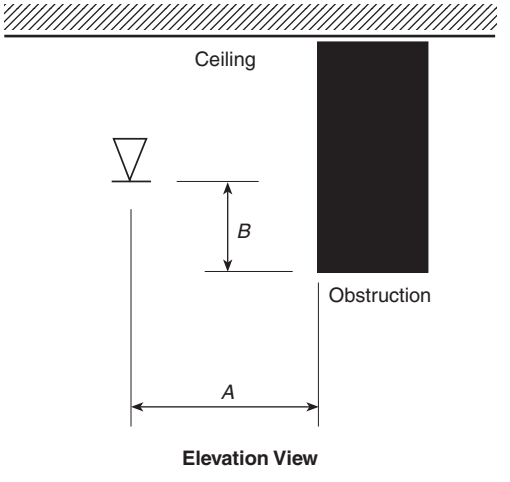

FIGURE 6.4.6.3.6.2 Positioning of Sprinkler to Avoid Obstruction to Discharge (Residential Upright and Pendent Spray Sprinklers).

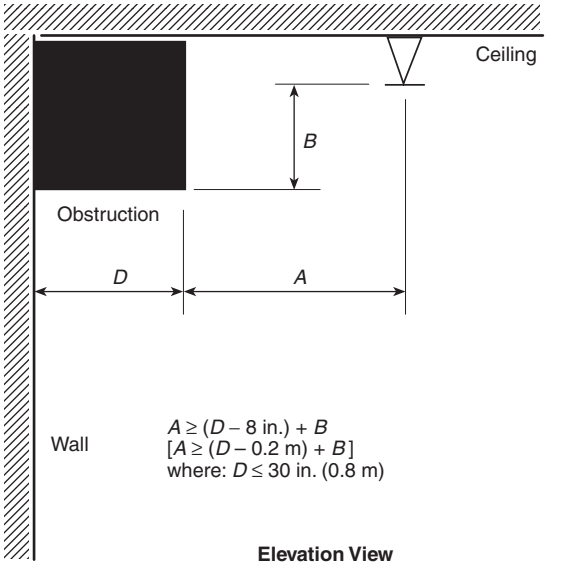

FIGURE 6.4.6.3.6.3(a) Positioning of Sprinkler to Avoid Obstruction Against Wall (Residential Upright and Pendent Spray Sprinklers).

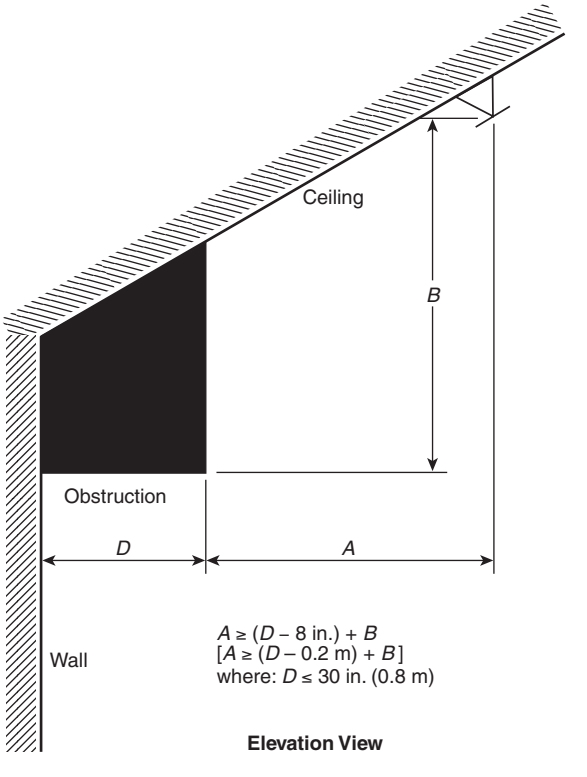

FIGURE 6.4.6.3.6.3(b) Positioning of Sprinkler to Avoid Obstruction Against Wall (Residential Upright and Pendent Spray Sprinklers).

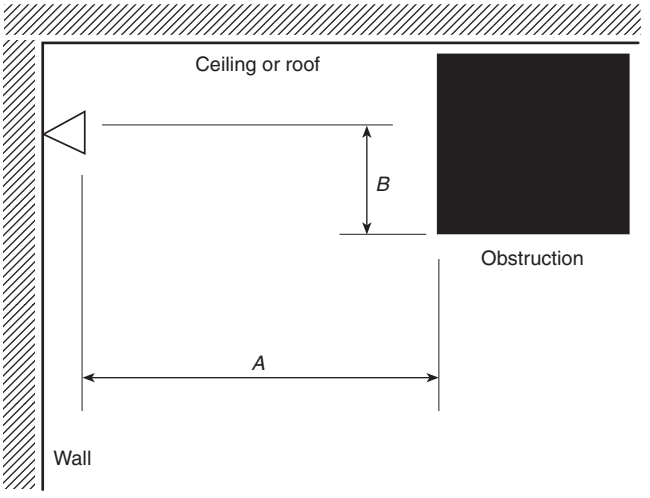

FIGURE 6.4.6.3.7.2(a) Positioning of Sprinkler to Avoid Obstruction (Residential Sidewall Sprinklers).

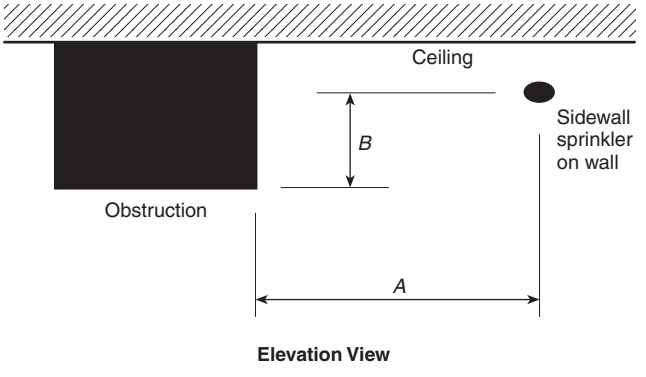

FIGURE 6.4.6.3.7.2(b) Positioning of Sprinkler to Avoid Obstruction Along Wall (Residential Sidewall Sprinklers).

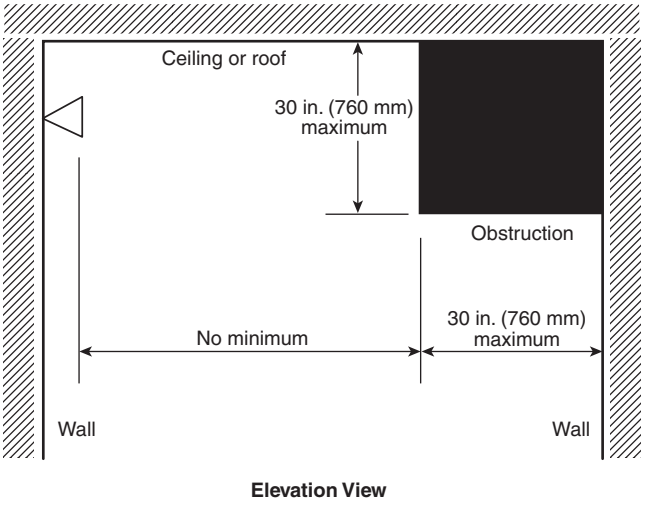

FIGURE 6.4.6.3.7.2(c) Positioning of Sprinkler to Avoid Obstruction Against Wall (Residential Sidewall Sprinklers).

Table 6.4.6.3.7.2(a) Positioning of Sprinklers to Avoid Obstructions (Residential Sidewall Sprinklers)

Distance from Sidewall Sprinkler to Side of Obstruction (*A*)	Maximum Allowable Distance of Deflector Above Bottom of Obstruction (in.) (*B*)
Less than 8 ft (2.4 m [2400 mm])	Not allowed
8 ft (2.4 m [2400 mm]) to less than 10 ft (3 m [3000 mm])	1 (25 mm)
10 ft (3 m [3000 mm]) to less than 11 ft (3.3 m [3300 mm])	2 (50 mm)
11 ft (3.3 m [3300 mm]) to less than 12 ft (3.6 m [3600 mm])	3 (75 mm)
12 ft (3.6 m [3600 mm]) to less than 13 ft (3.9 m [3900 mm])	4 (100 mm)
13 ft (3.9 m [3900 mm]) to less than 14 ft (4.2 m [4200 mm])	6 (150 mm)
14 ft (4.2 m [4200 mm]) to less than 15 ft (4.5 m [4500 mm])	7 (175 mm)
15 ft (4.5 m [4500 mm]) to less than 16 ft (4.8 m [4800 mm])	9 (225 mm)
16 ft (4.8 m [4800 mm]) to less than 17 ft (5.1 m [5100 mm])	11 (275 mm)
17 ft (5.1 m [5100 mm]) or greater	14 (350 mm)

For SI units, 1 in. = 25 mm; 1 ft = 0.30 m.
Note: For *A* and *B*, refer to Figure 6.4.6.3.7.2(a).

Table 6.4.6.3.7.2(b) Positioning of Sprinklers to Avoid Obstructions Along Wall (Residential Sidewall Sprinklers)

Distance from Sidewall Sprinkler to Side of Obstruction (*A*)	Maximum Allowable Distance of Deflector Above Bottom of Obstruction (in.) (*B*)
Less than 1 ft 6 in. (0.45 m [450 mm])	0
1 ft 6 in. (0.45 m [450 mm]) to less than 3 ft (0.9 m [900 mm])	1 (25 mm)
3 ft (0.9 m [900 mm]) to less than 4 ft (1.2 m [1200 mm])	3 (75 mm)
4 ft (1.2 m [1200 mm]) to less than 4 ft 6 in. (1.35 m [1350 mm])	5 (125 mm)
4 ft 6 in. (1.35 m [1350 mm]) to less than 6 ft (1.8 m [1800 mm])	7 (175 mm)
6 ft (1.8 m [1800 mm]) to less than 6 ft 6 in. (1.95 m [1950 mm])	9 (225 mm)
6 ft 6 in. (1.95 m [1950 mm]) to less than 7 ft (2.1 m [2100 mm])	11 (275 mm)
7 ft (2.1 m [2100 mm]) to less than 7 ft 6 in. (2.3 m [2300 mm])	14 (350 mm)

For SI units, 1 in. = 25 mm; 1 ft = 0.30 m.
Note: For *A* and *B*, refer to Figure 6.4.6.3.7.2(b).

6.4.6.3.7.3 A sprinkler shall be installed on the other side of the obstruction.

6.4.6.3.8 Soffits and Cabinets. Where soffits are used for the installation of sidewall sprinklers, the sprinklers and soffits shall be installed in accordance with 6.4.6.3.8.1, 6.4.6.3.8.2, or 6.4.6.3.8.3.

6.4.6.3.8.1 Where soffits exceed more than 8 in. (203 mm) in width or projection from the wall, pendent sprinklers shall be installed under the soffit.

6.4.6.3.8.2 Sidewall sprinklers shall be permitted to be installed in the face of a soffit located directly over cabinets, without requiring additional sprinklers below the soffit or cabinets, where the soffit does not project horizontally more than 12 in. (305 mm) from the wall.

6.4.6.3.8.3 Where sidewall sprinklers are more than 3 ft (914 mm) above the top of cabinets, the sprinkler shall be permitted to be installed on the wall above the cabinets where the cabinets are no greater than 12 in. (305 mm) from the wall.

6.5 Special Situations.

6.5.1 Return Bends.

6.5.1.1 Unless the requirements of 6.5.1.2 or 6.5.1.3 are met, return bends shall be used where pendent sprinklers are supplied from a raw water source, a millpond, or open-top reservoirs.

6.5.1.2 Return bends shall be connected to the top of branch lines in order to avoid accumulation of sediment in the drop nipples in accordance with Figure 6.5.1.2.

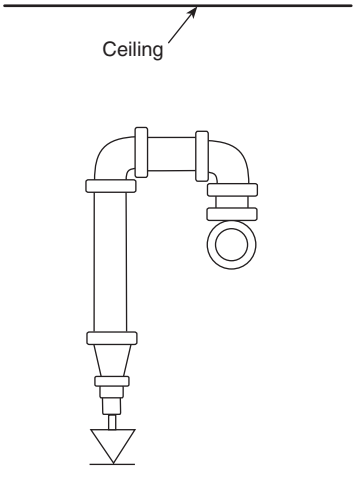

FIGURE 6.5.1.2 Return Bend Arrangement.

6.5.1.3 Return bends shall not be required where dry pendent sprinklers are used.

6.5.2 Dry Pipe Underground.

6.5.2.1 Where necessary to place pipe that is under air pressure underground, the pipe shall be protected against corrosion.

6.5.2.2 Unprotected cast-iron or ductile-iron pipe shall be permitted where joined with a gasketed joint listed for air service underground.

6.5.3 A test connection shall be installed that permits the testing of the alarm mechanisms.

6.5.4* Sprinkler-Protected Glazing. Where sprinklers are used in combination with glazing as an alternative to a required fire-rated wall or window assembly, the sprinkler-protected assembly shall comply with the following:

(1) Sprinklers shall be listed as specific application window sprinklers unless the standard spray sprinklers are specifically permitted by the building code.
(2) Sprinklers shall be supplied by a wet-pipe system.
(3) Glazing shall be heat-strengthened, tempered, or glass ceramic and shall be fixed.
(4) Where the assembly is required to be protected from both sides, sprinklers shall be installed on both sides of the glazing.
(5) The use of sprinkler-protected glazing shall be limited to non-load-bearing walls.
(6) The glazed assembly shall not have any horizontal members that would interfere with uniform distribution of water over the surface of the glazing, and there shall be no obstructions between sprinklers and glazing that would obstruct water distribution.
(7) The water supply duration for the design area that includes the window sprinklers shall not be less than the required rating of the assembly.

6.6 Location of Sprinklers.

6.6.1 Sprinklers shall be installed in all areas except where omission is permitted by 6.6.2 through 6.6.7.

6.6.2* Sprinklers shall not be required in bathrooms where the bathroom area does not exceed 55 ft^2 (5.1 m^2).

6.6.3 Except where specified in 6.6.4, sprinklers shall not be required in clothes closets, linen closets, and pantries within dwelling units that meet all of the following conditions:

(1) The area of the space does not exceed 24 ft^2 (2.2 m^2).
(2) The walls and ceilings are surfaced with noncombustible or limited-combustible materials as defined by NFPA 220.

6.6.4* Sprinklers shall be installed in any closet used for heating or air-conditioning equipment, washers, dryers, or water heaters except as permitted by 6.6.7.

6.6.5* Except as provided for in 6.6.5.1, sprinklers shall not be required in any porches, balconies, corridors, carports, porte cocheres, and stairs that are open and attached.

6.6.5.1 Where a roof or deck is provided above, sprinklers shall be installed to protect attached exterior balconies, attached exterior decks, and ground floor patios serving dwelling units in buildings of Construction Type V.

6.6.5.1.1 Where sidewall sprinklers are installed beneath decks or balconies constructed with open wood joists, sprinklers shall be permitted to be installed with deflectors not less than 1 in. (25 mm) or more than 6 in. (152 mm) below the structural members, provided that the deflector is not more than 14 in. (356 mm) below the underside surface of the deck.

6.6.6* Sprinklers shall not be required in attics, penthouse equipment rooms, elevator machine rooms, concealed spaces dedicated exclusively to and containing only dwelling unit

ventilation equipment, crawl spaces, floor/ceiling spaces, elevator shafts where the elevator installation complies with ANSI A17.1, *Safety Code for Elevators and Escalators,* and other concealed spaces that are not intended for living purposes or storage and do not contain fuel-fired equipment.

6.6.6.1 When fuel-fired equipment is present, at least one quick-response intermediate temperature sprinkler shall be installed above the equipment.

6.6.7 Sprinklers shall not be required in closets (regardless of size) on exterior balconies and exterior breezeways/corridors, regardless of size, as long as the closet does not have doors or unprotected penetrations directly into the dwelling unit.

6.6.8 All situations regarding sprinkler location and position that are not directly discussed in NFPA 13R shall be in accordance with NFPA 13.

6.6.9 Interior Stairwells.

6.6.9.1 Except as allowed by 6.6.9.2, 6.6.9.3, and 6.6.9.4, sprinklers shall be installed throughout all interior, enclosed stairwells.

6.6.9.2* Sprinklers shall not be required underneath stair risers in dwelling units where the walls and ceilings are surfaced with noncombustible or limited-combustible finishes.

6.6.9.3 Closets located underneath stairs shall be protected in accordance with 6.4.6.3.2, 6.6.3, 6.6.4, and 6.6.7.

6.6.9.4 Interior stairwells located outside the dwelling unit shall be protected in accordance with NFPA 13.

6.7 Piping.

6.7.1 Installation of Piping.

6.7.1.1 Where solvent cement is used as the pipe and fittings bonding agent, sprinklers shall not be installed in the fittings prior to the fittings being cemented in place.

6.7.1.2 In existing buildings, CPVC cut-ins to active fire sprinkler systems shall follow the manufacturer's recommended cut-in procedure.

6.7.2 Protection of Piping.

6.7.2.1* Freezing. Where aboveground water-filled supply pipes, risers, system risers, feed mains, or branch lines pass through open areas, cold rooms, passageways, or other areas exposed to freezing temperatures, the pipe shall be protected against freezing by insulating coverings, frostproof casings, listed heat tracing systems, or other reliable means capable of maintaining a minimum temperature between 40°F and 120°F (4°C and 48.9°C). *(See also 5.4.2.)*

6.7.2.2 Heat Tracing.

6.7.2.2.1 Where listed heat tracing systems are used, they shall be supervised.

6.7.2.2.1.1 Electric supervision of the heat tracing system shall provide positive confirmation that the circuit is energized.

6.7.2.2.2 Where listed heat tracing is utilized for branch lines, it shall be specifically listed for use on branch lines.

6.7.2.2.3 Heat tracing systems shall be supervised by one of the following methods:

(1) Central station, proprietary, or remote station signaling service
(2) Local signaling service that will cause a signal at a constantly attended location

6.7.2.3 Corrosion.

6.7.2.3.1 Where corrosive conditions are known to exist due to moisture or fumes from corrosive chemicals, or both, special types of fittings, pipes, and hangers that resist corrosion shall be used, or a protective coating shall be applied to all unprotected exposed surfaces of the sprinkler system.

6.7.2.3.2 Where water supplies are known to have unusual corrosive properties and threaded or cut-groove steel pipe is to be used, wall thickness shall be in accordance with Schedule 30 [in sizes 8 in. (200 mm) or larger] or Schedule 40 [in sizes less than 8 in. (200 mm)].

6.7.2.3.3 Where corrosive conditions exist or piping is exposed to the weather, corrosion-resistant types of pipe, fittings, and hangers or protective corrosion-resistant coatings shall be used.

6.7.2.3.4 Where steel pipe is used underground, the pipe shall be protected against corrosion.

6.7.2.4 Hazardous Areas.

6.7.2.4.1 Private service main aboveground piping shall not pass through hazardous areas, except as permitted in 6.7.2.4.2, and shall be located so that it is protected from mechanical and fire damage.

6.7.2.4.2 Private service main aboveground piping shall be permitted to be located in hazardous areas protected by an automatic sprinkler system.

6.7.2.5 Risers Subject to Mechanical Damage. Sprinkler risers subject to mechanical damage shall be protected by steel posts, concrete barriers, or other approved means.

6.8 Valves.

6.8.1 A single control valve arranged to shut off both the domestic system and the sprinkler system shall be installed for systems with common sprinkler/domestic mains unless a separate shutoff valve for the sprinkler system is installed in accordance with 6.8.2.

6.8.2 The sprinkler system piping shall not have a separate control valve installed unless supervised by one of the following methods:

(1) Central station, proprietary, or remote station alarm service
(2) Local alarm service that causes the sounding of an audible signal at a constantly attended location
(3) Valves that are locked open

6.8.3 A separate shutoff valve shall be installed for the domestic water supply in installations having a common sprinkler/domestic main.

6.8.4 System control or shutoff valves shall be of the slow-closing type.

6.8.5 A listed backflow prevention assembly shall be considered a check valve, and an additional check valve shall not be required.

6.8.6 A listed backflow prevention assembly shall be considered a control valve, and an additional control valve shall not be required.

6.8.7 The control valve for a system or portion of a system protecting a dwelling unit shall not be located in a different dwelling unit than the unit it serves.

6.8.8* Backflow Prevention Valves. Means shall be provided downstream of all backflow prevention valves for forward flow tests at a minimum flow rate of the system demand.

6.9* Drains.

6.9.1 Each sprinkler system shall have a drain on the system side of the control valve.

6.9.2 The drain pipe shall be at least 1 in. (25 mm) nominal diameter.

6.9.3 A valve shall be installed in the drain piping.

6.9.4 A ½ in. (13 mm) drain shall be installed for each trapped portion of a dry system that is subject to freezing temperatures.

6.10* Test Connection.

6.10.1 Each sprinkler system shall have a test connection.

6.10.2 The test connection pipe shall be at least 1 in. (25 mm) nominal diameter and terminate in an orifice equal to or smaller than the same size as the smallest sprinkler installed in the system.

6.10.3 A valve shall be installed in the test connection piping.

6.10.4 When the drain required in 6.9.1 is arranged as a test connection, a separate test connection shall not be required.

6.11* Fire Department Connection.

6.11.1 At least one fire department connection shall be provided for buildings, accessible by a fire department, that exceed 2000 ft^2 (186 m^2) or are more than a single story.

6.11.2 Fire department connections shall be at least 1½ in. (38 mm).

6.11.3 Each fire department connection to sprinkler systems shall be designated by a sign having raised or engraved letters at least 1 in. (25.4 mm) in height on plate or fitting reading service design — for example, AUTOSPKR., OPEN SPKR., AND STANDPIPE.

6.11.4 The piping between the check valve and the outside hose coupling shall be equipped with an approved automatic drip in areas subject to freezing.

6.11.5* Fire department connections shall be permitted to connect to the underground piping dedicated to the sprinkler system where the pipe is rated for a pressure of at least 175 psi (12.1 bar).

6.11.5.1 Where the underground pipe is nonmetallic, the pressure rating shall be based on a temperature of at least 120°F (50°C).

6.12 Pressure Gauges.

6.12.1 A pressure gauge with shutoff valve shall be provided to indicate pressure of the supply.

6.12.2 A pressure gauge with shutoff valve shall be provided to indicate pressure of the system.

6.13* Piping Support. Piping hanging and bracing methods shall comply with NFPA 13.

6.14 Open-Grid Ceilings. Open-grid ceilings shall be installed only as permitted by NFPA 13.

6.15 Drop-Out Ceilings. Drop-out ceilings shall be permitted to be installed beneath sprinklers where ceilings are listed for that service and are installed in accordance with their listings.

6.16* Alarms.

6.16.1 A local waterflow alarm shall be provided on all sprinkler systems.

6.16.2 Where a building fire alarm system is provided, the local waterflow alarms shall be connected to the building fire alarm system.

6.16.3 Waterflow alarms shall be installed in accordance with NFPA 13.

6.16.4 Where a building fire alarm system is provided, the building fire sprinkler system shall not be required to be zoned by floor.

Chapter 7 Discharge Criteria

7.1 Design Criteria — Inside Dwelling Unit.

7.1.1 Residential Sprinklers.

7.1.1.1* The system shall provide at least the flow required to produce a minimum discharge density of 0.05 gpm/ft^2 (2.04 mm/min) or the sprinkler listing, whichever is greater, to the design sprinklers.

7.1.1.2 Listed flows associated with testing under a smooth, flat, horizontal 8 ft (2.44 m) high ceiling shall be permitted to be used for the ceiling configurations referenced in 7.1.1.3.1.

7.1.1.3* Number of Design Sprinklers.

7.1.1.3.1 For each of the following situations, the number of sprinklers in the design area shall be all of the sprinklers within a compartment, up to a maximum of four sprinklers, that require the greatest hydraulic demand:

(1) A flat, smooth, horizontal ceiling with no beams up to a maximum of 24 ft (7.3 m) above the floor.
(2) A flat, horizontal, beamed ceiling, with a maximum ceiling height of 24 ft (7.3 m), with beams up to 14 in. (355 mm) deep with pendent sprinklers under the beams. The compartment containing the beamed ceiling shall be a maximum of 600 ft^2 (55 m^2) in area. The highest sprinkler in the compartment shall be above all openings from the compartment into any communicating spaces.
(3) A smooth, flat, sloped ceiling with no beams up to a maximum slope of 8 in 12. The highest portion of the ceiling shall not be more than 24 ft (7.3 m) above the floor. The highest sprinkler in the sloped portion of the ceiling shall be above all openings from the compartment containing the sloped ceiling into any communicating spaces.
(4) A sloped ceiling with beams up to 14 in. (355 mm) deep with pendent sprinklers under the beams. The compartment containing the sloped, beamed ceiling shall be a maximum of 600 ft^2 (55 m^2) in area. The slope of the ceiling shall be between 2 in 12 and 8 in 12. The highest portion of the ceiling shall not be more than 24 ft (7.3 m) above the floor. The highest sprinkler in the sloped portion of the ceiling shall be above all openings from the

compartment containing the sloped ceiling into any communicating spaces.

(5) A sloped ceiling with beams of any depth with sidewall or pendent sprinklers in each pocket formed by the beams. The compartment containing the sloped, beamed ceiling shall be a maximum of 600 ft^2 (55 m^2) in area. The slope of the ceiling shall be between 2 in 12 and 8 in 12. The highest portion of the ceiling shall not be more than 24 ft (7.3 m) above the floor.

7.1.1.3.2 For situations not meeting one of the conditions in 7.1.1.3.1, residential sprinklers listed for use in specific ceiling configurations shall be permitted to be used in accordance with their listing.

7.1.1.3.3* For situations not meeting one of the conditions in 7.1.1.3.1 and 7.1.1.3.2, the number of sprinklers in the design area shall be determined in consultation with the authority having jurisdiction as appropriate for the conditions.

7.1.2 Quick-Response Sprinklers. Where quick-response sprinklers are used in accordance with 6.2.1.3, the discharge and design area requirements of NFPA 13 shall apply.

7.2* Design Criteria — Outside Dwelling Unit.

7.2.1 Areas outside the dwelling unit shall comply with Section 7.2.

7.2.2 The number of design sprinklers for a corridor or breezeway outside the dwelling unit shall include up to the four most hydraulically demanding adjacent sprinklers.

7.2.3 The design discharge and design area criteria for areas protected by quick-response sprinklers shall comply with NFPA 13 except as allowed by 7.2.3.1.

7.2.3.1 For compartments 500 ft^2 (46 m^2) or less that meet all of the following conditions and are protected with quick-response sprinklers, the design area shall be permitted to be limited to the number of sprinklers in the compartment but shall not exceed four sprinklers:

(1) The area is protected with 30 minute–rated construction.
(2) The sprinklers are spaced at 225 ft^2 (20.9 m^2) maximum for light hazard, 130 ft^2 (12 m^2) maximum for ordinary hazard, or in accordance with their listing.
(3) Openings have a lintel depth at least 8 in. (203 mm) in depth.
(4) The total area of openings, excluding any overhead doors that open to the exterior, does not exceed 50 ft^2 (4.6 m^2) for each compartment.
(5) Discharge densities are in accordance with NFPA 13.

7.2.4 Where residential sprinklers are used outside the dwelling unit as allowed by 6.2.2.2, the discharge criteria shall be in accordance with Section 7.1, except as modified by 7.2.4.1.

7.2.4.1 Residential sprinklers shall be permitted to be used in ordinary hazard areas that meet the following conditions:

(1) The area is compartmented into 500 ft^2 (46 m^2) or less by 30-minute fire-rated construction.
(2) The sprinklers are spaced at 130 ft^2 (12 m^2) per sprinkler.
(3) Openings have a lintel at least 8 in. (203 mm) in depth.
(4) The total area of openings, excluding any overhead garage doors that open to the exterior, does not exceed 50 ft^2 (4.6 m^2) for each compartment.
(5) Discharge densities are in accordance with NFPA 13 for ordinary hazard.

7.2.5 The number of design sprinklers for a corridor or breezeway outside the dwelling unit shall include up to the four most hydraulically demanding adjacent sprinklers.

7.3 Design Criteria — Garages.

7.3.1 Garages that are completely separated from the residential portion of the building by fire-resistive construction sufficient to have them considered separate buildings under the local code shall be protected in accordance with NFPA 13.

7.3.2 Garages that are accessible by people from more than one dwelling unit, and are not covered by 7.3.1, shall be considered part of the building and shall be protected in accordance with Section 7.2.

7.3.2.1 Garage doors shall not be considered obstructions and shall be permitted to be ignored for placement and calculation of sprinklers.

7.3.3* Garages that are accessible only from a single dwelling unit shall be considered as part of that dwelling unit.

7.3.3.1 Garages that meet the criteria of 7.3.3 shall be protected in accordance with one of the following:

(1) Use of a residential sprinkler in accordance with Section 7.1
(2) Use of an extended coverage sprinkler discharging water not less than its listed flow rate for light hazard
(3) Quick-response spray sprinkler at light hazard spacing in accordance with NFPA 13 designed to discharge at 0.05 gpm/ft^2 (2.04 mm/min) density

7.3.3.2 The system demand shall be permitted to be limited to the number of sprinklers in the compartment but shall not exceed four sprinklers.

7.3.3.3 Garage doors shall not be considered obstructions and shall be permitted to be ignored for placement and calculation of sprinklers.

7.4 Combustible Concealed Spaces. Where unsprinklered combustible concealed spaces are present in a building, the design area shall not be required to be increased to 3000 ft^2 (279 m^2) or any other value due to the existence of the unsprinklered concealed spaces, regardless of the type of sprinklers used and whether the area is inside or outside of a dwelling unit.

Chapter 8 Plans and Calculations

8.1 Working Plans.

8.1.1 Working plans shall be submitted for approval to the authority having jurisdiction before any equipment is installed or remodeled.

8.1.2 Deviations from approved plans shall require approval of the authority having jurisdiction.

8.1.3 Working plans shall be drawn to a specified scale.

8.1.4 Sprinkler plans shall be drawn on sheets of uniform size.

8.1.5 Sprinkler plans shall provide a plan of each floor.

8.1.5.1 It shall be acceptable to provide typical floor plans when applicable.

8.1.6 Sprinkler plans shall be capable of being easily duplicated.

8.1.7 Working plans shall be drawn to an indicated scale, on sheets of uniform size, with a plan of each floor, and shall show those items from the following list that pertain to the design of the system:

(1) Project name
(2) Location, including street address
(3) Point of compass
(4) Ceiling construction
(5) Full height cross-section or schematic diagram, including structural member information if required for clarity and including ceiling construction and method of protection for nonmetallic piping
(6) Ceiling/roof height and slopes not shown in the full height cross section
(7) Location of partitions and fire walls
(8) Location and size of concealed spaces, attics, closets, and bathrooms
(9) Any small enclosures in which no sprinklers are to be installed
(10) Size of the city main in the street and the city main test results including elevation of the test hydrant
(11) Make, manufacturer, type, temperature rating, sprinkler identification number, and nominal k-factor of the sprinkler
(12) Type and location of high-temperature sprinklers
(13) Number of sprinklers on each riser, per floor
(14) Type and location of alarm bells
(15) Type of pipe and fittings
(16) Pipe type and schedule of wall thickness
(17) Type of protection for nonmetallic pipe
(18) Location and size of riser nipples
(19) Types of fittings and joints and the locations of all welds and bends
(20) Types and locations of hangers, sleeves, and braces, and methods of securing sprinklers, where applicable
(21) All control valves, check valves, drain pipes, and test connections
(22) Underground pipe size, length, location, weight, material, and point of connection to the city main; type of valves, meters, and valve pits; and depth at which the top of the pipe is laid below grade
(23) Name and address of the contractor
(24) Nominal pipe size and lengths
(25) Where the equipment is to be installed as an addition to an existing system, enough of the existing system indicated on the plans to make all conditions clear
(26) A graphic representation of the scale used on all plans
(27) Hydraulic reference points shown on the plan that correspond with comparable reference points on the hydraulic calculation sheets
(28) The minimum rate of water application and the design area of water application
(29) The total quantity of water and the pressure required noted at a common reference point for each system
(30) Relative elevations of sprinklers, junction points, and supply or reference points
(31) Information about backflow preventers (manufacturer, size, type)
(32) Information about antifreeze solution used (type and amount)
(33) Size and location of hydrants, showing size and number of outlets; static and residual hydrants that were used in flow tests shall be shown
(34) Size, location, and piping arrangement of fire department connections
(35) Location of fuel-fired equipment and heating and air-conditioning equipment
(36) Location of closets on exterior balconies, and any doors or penetration between the closet and the dwelling unit
(37) Edition year of NFPA 13R to which the sprinkler system is designed

8.2 Hydraulic Calculations.

8.2.1 Pipe Sizing. Piping shall be sized using hydraulic calculation procedures in accordance with NFPA 13.

8.2.2 A hydraulic calculation summary sheet shall be provided as shown in Figure 8.2.2.

Chapter 9 Water Supply

9.1 Automatic. Every sprinkler system shall have at least one automatic water supply.

9.2 Minimum. The water supply shall be capable of supplying the system demand for at least 30 minutes. *(See 7.1.1.3.)*

9.3* Source. The water supply source shall be one of the following:

(1)*A connection to a reliable waterworks system with or without a pump, as required
(2) An elevated tank
(3) A pressure tank installed in accordance with NFPA 13 and NFPA 22
(4)*A stored water source with an automatically operated fire pump

9.4 Fire Pump. Where a fire pump is installed, the fire pump shall be installed in accordance with NFPA 20.

9.5 Water Tanks. Where a water tank is installed, the water tank shall be installed in accordance with NFPA 22.

9.6* Domestic Demand. Domestic demand for the building being calculated shall be included as part of the overall system demand for systems with common domestic/fire mains where no provisions are made to prevent the domestic waterflow upon sprinkler system activation.

9.7 Non–Fire Protection Connections. Sprinkler systems with non–fire protection connections shall not be permitted.

Chapter 10 System Acceptance

10.1 Approval of Sprinkler Systems.

10.1.1 The installer shall perform all required acceptance tests *(see Section 10.2)* prior to asking for approval of the installation.

10.1.2 The installer shall complete the contractor's material and test certificate(s) as shown in Figure 10.1.2 prior to asking for approval of the installation.

PROJECT GENERAL INFORMATION

Project name _____ Date ____/____/____

Location/address _____

Owner/occupant _____

Installing contractor's name _____ Phone ( ) _____

Installing contractor's address _____

Designer _____ Phone ( ) _____

Authority having jurisdiction(s) _____

SYSTEM DESIGN REQUIREMENTS

Design area name or number _____ NFPA 13R design edition _____

Design area location _____ Drawing/sheet # _____

Dwelling unit calculation ❑ or Outside dwelling unit calculation ❑ Other

System type Wet ❑ Dry or Preaction ❑ System volume _____ gal Antifreeze ❑ Other ❑

Sprinkler type Standard coverage ❑ Extended coverage ❑ Residential ❑ Other ❑

Maximum coverage per sprinkler _____ ft^2

Minimum rate of water application _____ gpm/ft^2

Design area of application (outside of dwelling unit) _____ ft^2

Number of sprinklers calculated (dwelling, corridor, garage) _____

Limitations for extended coverage or special sprinklers _____

_____

_____

Elevation of highest calculated sprinkler _____ ft

Total system demand at source (gpm at psi) _____

Meter size _____ Make and model _____

WATER SUPPLY INFORMATION

Date of test ____/____/____ Time of test ____ : ____ am/pm

Location of test hydrant _____

Elevation of test hydrant relative to project finished floor _____ ft

Location of flow hydrant(s) _____

Source of water for flow test _____

Size of fire pump (gpm at psi) _____ Size of water tank (gal) _____

Notes _____

_____

_____

_____

FIGURE 8.2.2 Summary Sheet for Hydraulic Calculations.

10.1.3 The installer shall forward the certificate(s) to the authority having jurisdiction prior to asking for approval of the installation.

10.1.4 Where the authority having jurisdiction is required to be present when acceptance tests are conducted, the installer shall provide advance notification of the time and date the testing will be performed.

10.2 Acceptance Tests.

10.2.1* Flushing of Underground Connections.

10.2.1.1 Underground mains and lead-in connections to system risers shall be flushed before a connection is made to sprinkler piping.

Contractor's Material and Test Certificate for Aboveground Piping

PROCEDURE

Upon completion of work, inspection and tests shall be made by the contractor's representative and witnessed by the property owner or their authorized agent. All defects shall be corrected and system left in service before contractor's personnel finally leave the job.

A certificate shall be filled out and signed by both representatives. Copies shall be prepared for approving authorities, owners, and contractor. It is understood the owner's representative's signature in no way prejudices any claim against contractor for faulty material, poor workmanship, or failure to comply with approving authority's requirements or local ordinances.

Property name	Date
Property address	

Plans	Accepted by approving authorities (names)		
	Address		
	Installation conforms to accepted plans	❑ Yes	❑ No
	Equipment used is approved If no, explain deviations	❑ Yes	❑ No
Instructions	Has person in charge of fire equipment been instructed as to location of control valves and care and maintenance of this new equipment? If no, explain	❑ Yes	❑ No
	Have copies of the following been left on the premises?	❑ Yes	❑ No
	1. System components instructions	❑ Yes	❑ No
	2. Care and maintenance instructions	❑ Yes	❑ No
	3. NFPA 25	❑ Yes	❑ No
Location of system	Supplies buildings		

Sprinklers	Make	Model	Year of manufacture	Orifice size	Quantity	Temperature rating

Pipe and fittings: Type of pipe _____
Type of fittings _____

Alarm valve or flow indicator	Alarm device			Maximum time to operate through test connection	
	Type	Make	Model	Minutes	Seconds

Dry pipe operating test	Dry valve			Q. O. D.		
	Make	Model	Serial no.	Make	Model	Serial no.

	Time to trip through test connection[a,b]		Water pressure	Air pressure	Trip point air pressure	Time water reached test outlet[a,b]		Alarm operated properly	
	Minutes	Seconds	psi	psi	psi	Minutes	Seconds	Yes	No
Without Q.O.D.									
With Q.O.D.									

If no, explain

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[a] Measured from time inspector's test connection is opened
[b] NFPA 13 only requires the 60-second limitation in specific sections

FIGURE 10.1.2 Contractor's Material and Test Certificate for Aboveground Piping. [13:Figure 25.1]

Deluge and preaction valves

Operation ❑ Pneumatic ❑ Electric ❑ Hydraulics

Piping supervised ❑ Yes ❑ No | Detecting media supervised ❑ Yes ❑ No

Does valve operate from the manual trip, remote, or both control stations? ❑ Yes ❑ No

Is there an accessible facility in each circuit for testing? ❑ Yes ❑ No | If no, explain

Make	Model	Does each circuit operate supervision loss alarm?		Does each circuit operate valve release?		Maximum time to operate release	
		Yes	No	Yes	No	Minutes	Seconds

Pressure-reducing valve test

Location and floor	Make and model	Setting	Static pressure		Residual pressure (flowing)		Flow rate
			Inlet (psi)	Outlet (psi)	Inlet (psi)	Outlet (psi)	Flow (gpm)

Test description

~~Hydrostatic:~~ Hydrostatic tests shall be made at not less than 200 psi (13.6 bar) for 2 hours or 50 psi (3.4 bar) above static pressure in excess of 150 psi (10.2 bar) for 2 hours. Differential dry pipe valve clappers shall be left open during the test to prevent damage. All aboveground piping leakage shall be stopped.

~~Pneumatic:~~ Establish 40 psi (2.7 bar) air pressure and measure drop, which shall not exceed 1½ psi (0.1 bar) in 24 hours. Test pressure tanks at normal water level and air pressure and measure air pressure drop, which shall not exceed 1½ psi (0.1 bar) in 24 hours.

Tests

All piping hydrostatically tested at ____ psi (____ bar) for ____ hours ❑ Yes ❑ No
Dry piping pneumatically tested ❑ Yes ❑ No
Equipment operates properly ❑ Yes ❑ No | If no, state reason

Do you certify as the sprinkler contractor that additives and corrosive chemicals, sodium silicate or derivatives of sodium silicate, brine, or other corrosive chemicals were not used for testing systems or stopping leaks? ❑ Yes ❑ No

Drain test | Reading of gauge located near water supply test connection: ____ psi (____ bar) | Residual pressure with valve in test connection open wide: ____ psi (____ bar)

Underground mains and lead-in connections to system risers flushed before connection made to sprinkler piping
Verified by copy of the Contractor's Material and Test Certificate for Underground Piping. ❑ Yes ❑ No
Flushed by installer of underground sprinkler piping ❑ Yes ❑ No | Other Explain

If powder-driven fasteners are used in concrete, has representative sample testing been satisfactorily completed? ❑ Yes ❑ No | If no, explain

Blank testing gaskets

Number used	Locations	Number removed

Welding

Welding piping ❑ Yes ❑ No

If yes . . .

Do you certify as the sprinkler contractor that welding procedures used complied with the minimum requirements of AWS B2.1, ASME Section IX *Welding and Brazing Qualifications,* or other applicable qualification standard as required by the AHJ? ❑ Yes ❑ No

Do you certify that all welding was performed by welders or welding operators qualified in accordance with the minimum requirements of AWS B2.1, ASME Section IX *Welding and Brazing Qualifications,* or other applicable qualification standard as required by the AHJ? ❑ Yes ❑ No

Do you certify that the welding was conducted in compliance with a documented quality control procedure to ensure that (1) all discs are retrieved; (2) that openings in piping are smooth, that slag and other welding residue are removed; (3) the internal diameters of piping are not penetrated; (4) completed welds are free from cracks, incomplete fusion, surface porosity greater than 1/16 in. diameter, undercut deeper than the lesser of 25% of the wall thickness or 1/32 in.; and (5) completed circumferential butt weld reinforcement does not exceed 3/32 in.? ❑ Yes ❑ No

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FIGURE 10.1.2 ***Continued***

Cutouts (discs)	Do you certify that you have a control feature to ensure that all cutouts (discs) are retrieved? ❑ Yes ❑ No	
Hydraulic data nameplate	Nameplate provided ❑ Yes ❑ No	If no, explain
Sprinkler contractor removed all caps and straps? ❑ Yes ❑ No		
Remarks	Date left in service with all control valves open	
Signatures	Name of sprinkler contractor	
	Tests witnessed by	
	The property owner or their authorized agent (signed)	Title / Date
	For sprinkler contractor (signed)	Title / Date
Additional explanations and notes		

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FIGURE 10.1.2 ***Continued***

10.2.1.2 The flushing operation shall be continued until the water issuing from the main is clear.

10.2.1.3 The flushing operation shall be performed at the hydraulically calculated water demand rate of the system.

10.2.1.4 The flushing operation shall be performed such that the disposal of water issuing from the test outlets does not damage the property.

10.2.2* Hydrostatic Pressure Tests.

10.2.2.1 Systems having more than 20 sprinklers or having a fire department connection shall pass a hydrostatic pressure test performed for the aboveground piping system in accordance with NFPA 13.

10.2.2.2 Systems having both fewer than 20 sprinklers and no fire department connection shall pass a hydrostatic pressure test performed for the aboveground piping system at 50 psi (3.45 bar) higher than the maximum system pressure, using the hydrostatic test procedure specified in NFPA 13.

Chapter 11 Care and Maintenance

11.1 Stock of Spare Sprinklers.

11.1.1* A supply of at least six spare sprinklers shall be maintained on the premises so that any sprinklers that have operated or been damaged in any way can be promptly replaced.

11.1.2 The sprinklers shall correspond to the types and temperature ratings of the sprinklers in the property.

11.1.3 The sprinklers shall be kept in a cabinet located where the temperature to which they are subjected will at no time exceed 100°F (38°C).

11.1.3.1 The sprinklers shall be kept in a cabinet located where the temperature to which they are subjected will at no time exceed the maximum ceiling temperatures specified in Table 5.1.1.6.1 for each of the sprinklers within the cabinet.

11.1.4 Where dry sprinklers of different lengths are installed, spare dry sprinklers shall not be required, provided that a means of returning the system to service is furnished.

11.1.5 The stock of spare sprinklers shall include all types and ratings installed and shall be as follows:

(1) For protected facilities having under 300 sprinklers — no fewer than six sprinklers
(2) For protected facilities having 300 to 1000 sprinklers — no fewer than 12 sprinklers
(3) For protected facilities having over 1000 sprinklers — no fewer than 24 sprinklers

11.1.6* One sprinkler wrench as specified by the sprinkler manufacturer shall be provided in the cabinet for each type of sprinkler installed to be used for the removal and installation of sprinklers in the system.

11.1.7 A list of the sprinklers installed in the property shall be posted in the sprinkler cabinet.

11.1.7.1* The list shall include the following:

(1) Sprinkler Identification Number (SIN) if equipped; or the manufacturer, model, orifice, deflector type, thermal sensitivity, and pressure rating
(2) General description
(3) Quantity of each type to be contained in the cabinet
(4) Issue or revision date of the list

11.1.8* On a single property with multiple buildings under the same ownership, it shall be acceptable to provide the required spare sprinklers in a single location.

11.2* Owner's Responsibility. The owner shall be responsible for the condition of a sprinkler system and shall keep the system in normal operating condition.

11.3 Inspection, Testing, and Maintenance. Sprinkler systems shall be inspected, tested, and maintained in accordance with NFPA 25.

11.4 Instructions. The installing contractor shall provide the property owner or the property owner's authorized representative with the following:

(1) All literature and instructions provided by the manufacturer describing proper operation and maintenance of any equipment and devices installed
(2) A copy of NFPA 25

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.1 NFPA 13R is appropriate for use as an alternative to NFPA 13 only in those residential occupancies, as defined in this standard, up to and including four aboveground stories in height, and limited to buildings that are 60 ft (18 m) or less in height above grade plane, which is consistent with limits established by model building codes for buildings of Type V construction. The height of a building above grade plane is determined by model building codes, which base the height on the average height of the highest roof surface above grade plane. For further information on the building height story limits, see model building codes.

Buildings that contain multiple occupancies (either separated or non-separated), accessory occupancies or incidental uses are often subject to special rules that may restrict the use of NFPA 13R. Refer to the adopted building code to determine whether such restrictions are applicable.

The criteria in this standard are based on full-scale fire tests of rooms containing typical furnishings found in residential living rooms, kitchens, and bedrooms. The furnishings were arranged as typically found in dwelling units in a manner similar to that shown in Figure A.1.1(a), Figure A.1.1(b), and Figure A.1.1(c). Sixty full-scale fire tests were conducted in a two-story dwelling in Los Angeles, California, and 16 tests were conducted in a 14 ft (4.3 m) wide mobile home in Charlotte, North Carolina. Sprinkler systems designed and installed according to this standard are expected to prevent flashover within the compartment of origin where sprinklers are installed in the compartment. A sprinkler system designed and installed according to this standard cannot, however, be expected to completely control a fire involving fuel loads that are significantly higher than average for dwelling units [10 lb/ft^2 (49 kg/m^2)], configurations of fuels other than those with typical residential occupancies, or conditions where the interior finish has an unusually high flame spread index (greater than 225).

To be effective, sprinkler systems installed in accordance with this standard need to open the sprinklers closest to the fire before the fire exceeds the ability of the sprinkler discharge to extinguish or control the fire. Conditions that allow the fire to grow beyond that point before sprinkler activation or that interfere with the quality of water distribution can produce conditions beyond the capabilities of the sprinkler system described in this standard. Unusually high ceilings or ceiling configurations that tend to divert the rising hot gases from sprinkler locations or change the sprinkler discharge pattern from its standard pattern can produce fire conditions that cannot be extinguished or controlled by the systems described in this standard.

NFPA 13R references NFPA 13 in many aspects (hanging and bracing, design densities and spacing outside of dwelling unit, painting and finish of sprinklers, welding, etc.). If this standard does not specifically address a situation, NFPA 13 is a good resource that can be utilized by the installer and the authority having jurisdiction for a solution. It is not the intent of this standard to require compliance with NFPA 13 when NFPA 13R is silent on a subject. Only AHJ approval should be required.

A.1.2 Various levels of sprinkler protection are available to provide life safety and property protection. This standard is designed to provide a high, but not absolute, level of life safety and a lesser level of property protection. Greater protection to both life and property could be achieved by sprinklering all areas in accordance with NFPA 13, which permits the use of residential sprinklers in residential areas.

This standard recommends, but does not require, sprinklering of all areas in the building; it permits sprinklers to be omitted in certain areas. These areas have been proved by NFPA statistics to be those where the incidence of life loss from fires in residential occupancies is low. Such an approach provides a reasonable degree of fire safety. *(See Table A.1.2 for deaths and injuries in multifamily residential buildings.)*

It should be recognized that the omission of sprinklers from certain areas could result in the development of untenable conditions in adjacent spaces. Where evacuation times could be delayed, additional sprinkler protection and other fire protection features, such as detection and compartmentation, could be necessary.

A.1.5.1 For additional conversions and information, see IEEE/ASTM SI10, *Standard for Use of the International System of Units (SI): the Modern Metric System.*

A.1.5.4 A given equivalent value is considered to be approximate.

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

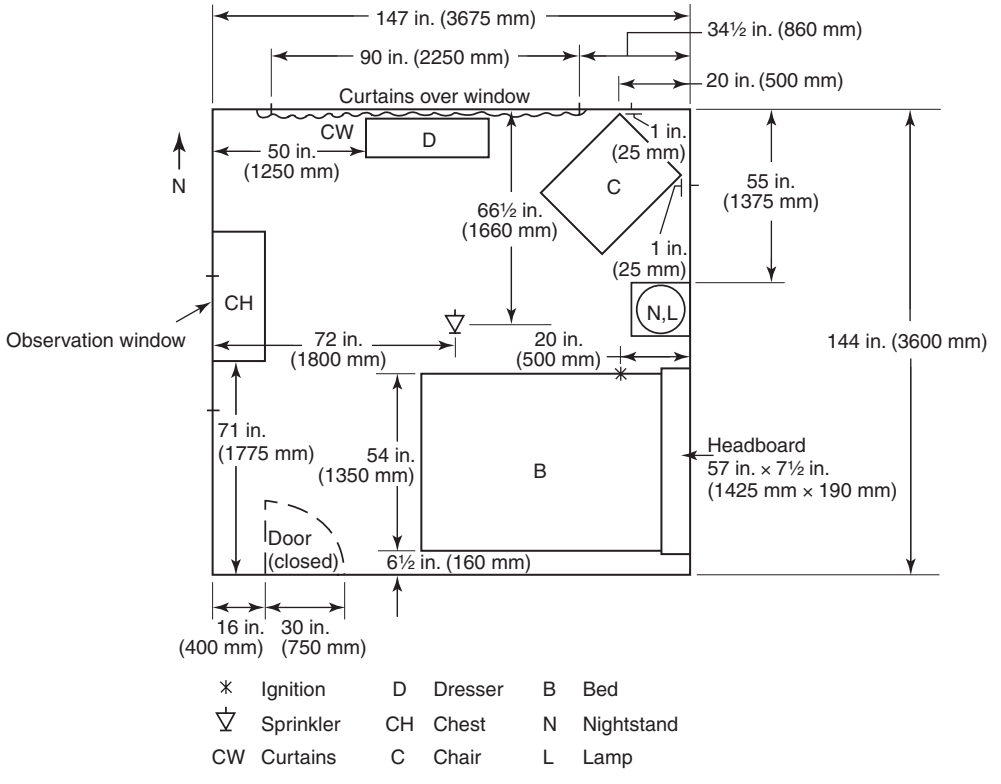


FIGURE A.1.1(a) Bedroom.

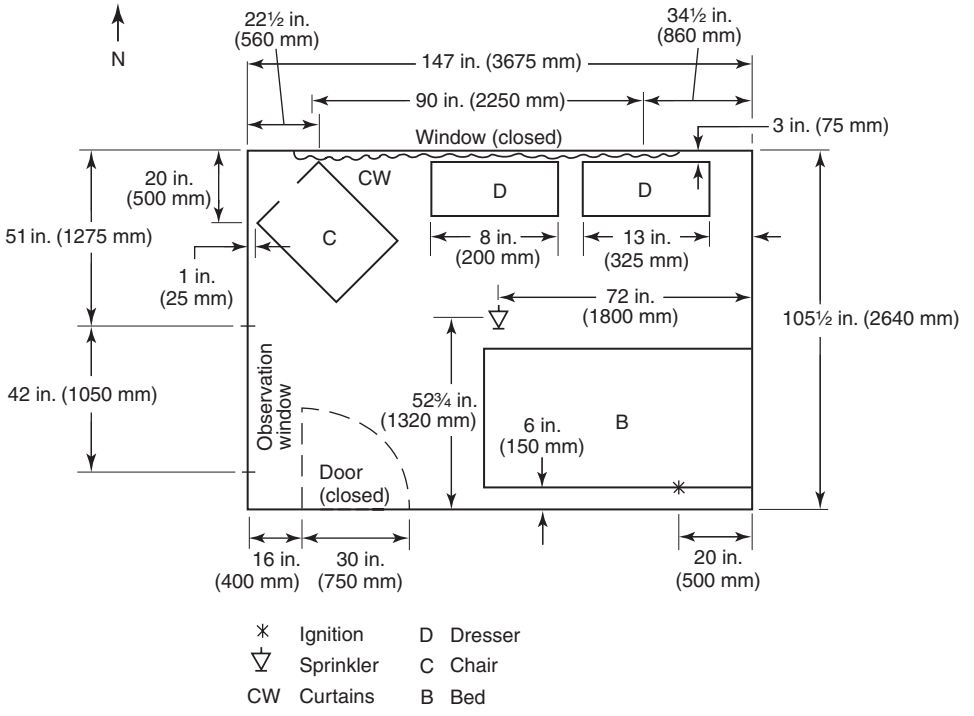


FIGURE A.1.1(b) Manufactured Home Bedroom.

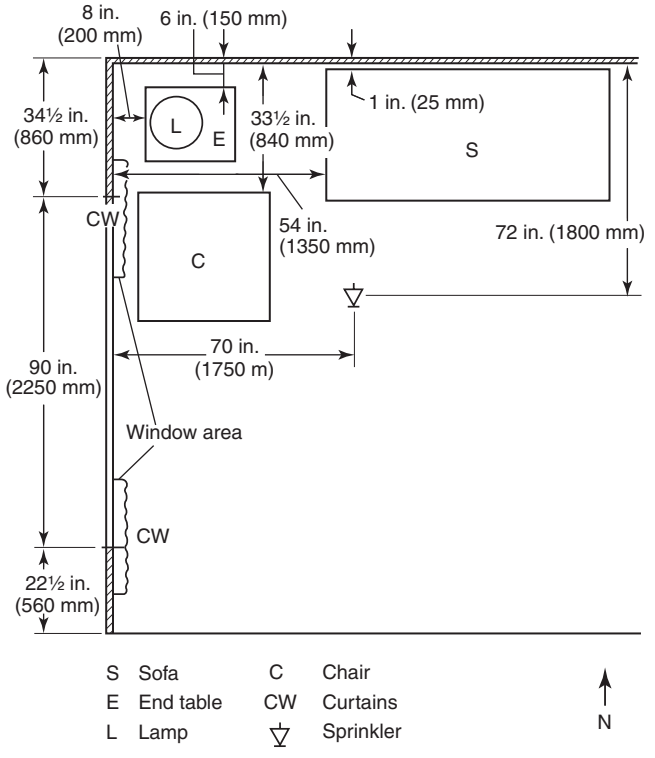


FIGURE A.1.1(c) Living Room.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.2.4 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.1 Bathroom. A room is still considered a bathroom if it contains just a toilet. Additionally, two bathrooms can be adjacent to each other and are considered separate rooms, provided they are enclosed with the required level of construction.

A.3.3.7.1 Light Hazard Occupancy. Light hazard occupancies include occupancies having uses and conditions similar to the following: churches; clubs; educational; hospitals; institutional; libraries, except large stack rooms; museums; nursing or convalescent homes; offices, including data processing; residential; restaurant seating areas; and theaters and auditoriums, excluding stages and prosceniums.

Table A.1.2 Fires and Associated Deaths and Injuries in Apartments by Area of Origin; Annual Average of 1986–1990 Structure Fires Reported to U.S. Fire Departments

Area of Origin	Civilian Deaths	Civilian Percent	Fires	Percent	Injuries	Percent
Bedroom	309	33.9	17,960	15.8	1,714	27.2
Living room, family room, or den	308	33.8	10,500	9.3	1,272	20.2
Kitchen	114	12.5	46,900	41.4	1,973	31.2
Interior stairway	29	3.2	1,040	0.9	91	1.4
Hallway or corridor	23	2.6	3,130	2.8	165	2.6
Exterior balcony or open porch	17	1.8	1,880	1.7	69	1.1
Dining room	10	1.1	800	0.7	69	1.1
Closet	9	1.0	2,120	1.9	116	1.8
Multiple areas	9	1.0	780	0.7	38	0.6
Tool room or other supply storage room or area	8	0.9	1,250	1.1	53	0.8
Unclassified area	8	0.9	480	0.4	29	0.5
Exterior stairway	8	0.8	870	0.8	22	0.4
Bathroom	7	0.7	2,510	2.2	101	1.6
Heating equipment room or area	6	0.6	2,510	2.2	75	1.2
Exterior wall surface	5	0.5	2,150	1.9	26	0.4
Laundry room or area	4	0.4	3,380	3.0	89	1.4
Crawl space or substructure space	4	0.4	1,490	1.3	62	1.0
Wall assembly or concealed space	3	0.4	1,020	0.9	21	0.3
Attic or ceiling/roof assembly or concealed space	3	0.3	1,100	1.0	18	0.3
Ceiling/floor assembly or concealed space	3	0.3	560	0.5	18	0.3
Garage or carport*	3	0.3	1,290	1.1	36	0.6
Lobby or entranceway	3	0.3	670	0.6	31	0.5
Unclassified structural area	3	0.3	520	0.5	32	0.5
Unclassified storage area	3	0.3	430	0.4	22	0.3
Unclassified function area	3	0.3	250	0.2	13	0.2
Laboratory	2	0.3	80	0.1	3	0.0
Elevator or dumbwaiter	1	0.2	220	0.2	4	0.1
Sales or showroom area	1	0.2	110	0.1	3	0.1
Exterior roof surface	1	0.1	1,040	0.9	15	0.2
Unclassified means of egress	1	0.1	180	0.2	6	0.1
Office	1	0.1	120	0.1	4	0.1
Chimney	1	0.1	980	0.9	2	0.0
Personal service area	1	0.1	40	0.0	4	0.1
Library	1	0.1	10	0.0	0	0.0
Other known area	2	0.2	5,000	4.4	115	1.8
Totals	912	100.0	113,390	100.0	6,313	100.0

Note: Fires are estimated to the nearest 10; civilian deaths and injuries are estimated to the nearest 1.
*Does not include dwelling garages coded as a separate property.
Source: 1986–1990 NFIRS and NFPA survey.

A.3.3.7.2 Ordinary Hazard (Group 1). Ordinary hazard occupancies (Group 1) include occupancies having uses and conditions similar to the following: automobile parking and showrooms, bakeries, laundries, and restaurant service areas.

A.3.3.7.3 Ordinary Hazard (Group 2). Ordinary hazard occupancies (Group 2) include occupancies having uses and conditions similar to the following: dry cleaners, horse stables, libraries — large stack room areas, mercantile, post offices, repair garages, and stages.

A.3.3.8 Raw Water Source. Examples of raw water sources are millponds, lakes, streams, open top reservoirs, and so forth. Examples of non-raw water sources can include city water supplies, cisterns, pressure tanks, gravity tanks, break tanks, aquifers, and so forth. Water sources that are closed or protected from direct contact with the environment should not be considered raw.

A.3.3.10 Shadow Area. Water is not required to fall on every square inch of floor space of the occupancy. This definition establishes a term that will be used to address the rules for acceptable dry spaces that occur when walls interfere with the sprinkler's spray pattern. Angled walls, wing walls, and slightly indented walls can disrupt water discharging from a sprinkler, which does not travel only in an absolute straight line, as if it were beams of light. Where small (typically triangular) shadowed areas are formed on the floor adjacent to the wall, these shadowed areas are purely on paper and do not take into ac-

count the dynamic variables of sprinkler discharge. In order to be acceptable, the shadow area needs to be within the coverage area of a sprinkler, meaning that water would discharge to the space directly if the structural or architectural feature was not there. The purpose of the shadow area is not to replace any existing obstruction requirements. Instead, the shadow area concept has been added to the standard to provide clarity to specific situations in which walls form non-rectangular-shaped rooms, as shown in Figure A.3.3.10.

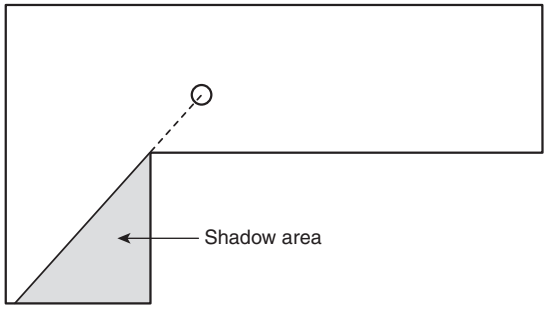


FIGURE A.3.3.10 Shadow Area Created by Wall.

A.5.1.1.1 Compatible thread sealant or Teflon tape can be used in a CPVC sprinkler head adapter. However, a combination of the two cannot be used together. The manufacturer of the sprinkler head adapter has listed installation instructions that must be followed for each sprinkler head adapter used.

A.5.1.1.1.1 Sprinklers should be permitted to be reinstalled when the sprinkler being removed from the system remains attached to the original fitting or welded outlet, provided care has been taken to ensure the sprinkler has not been damaged. Flexible hose connections are considered a fitting.

In new installations, where sprinklers are installed on pendent drop nipples or sidewall sprinklers prior to final cut-back, protective caps and/or straps should remain in place until after the drop nipple has been cut to fit to the final ceiling elevation.

A.5.1.1.2 It is recognized that the flow and pressure available to the replacement sprinkler might be less than its current flow and pressure requirement.

A.5.1.1.3 The four- to six-character sprinkler identification number, with no intervening spaces, is intended to identify the sprinkler operating characteristics in lieu of the traditional laboratory approval marking (e.g., SSU, SSP, EC, QR, etc.). The number, marked on the deflector of most sprinklers and elsewhere on decorative ceiling sprinklers, consists of one or two characters identifying the manufacturer, followed by three or four digits.

Sprinkler manufacturers have identified their manufacturer designations for the listing organizations. Each change in orifice size, response characteristics, or deflector (distribution) characteristics results in a new sprinkler identification number. The numbers do not identify specific characteristics of sprinklers but can be referenced in the database information compiled by the listing organizations. At the plan review stage, the sprinkler identification number should be checked against such a database or the manufacturer's literature to ensure that sprinklers are being used properly and within the limitations of their listings. Field inspections can include spot checks to ensure that the model numbers on the plans are those actually installed.

A.5.1.1.6 Information regarding the highest temperature that can be encountered in any location in a particular installation can be obtained by use of a thermometer that registers the highest temperature encountered. It should be hung for several days in the location in question.

A.5.1.1.7.2 The use of the wrong type of escutcheon with recessed or flush-type sprinklers can result in severe disruption of the spray pattern, which can destroy the effectiveness of the sprinkler.

A.5.1.1.9.1 Protective caps and straps are intended to provide temporary protection for sprinklers during shipping and installation.

A.5.1.1.9.2 Protective caps and straps can be removed from upright sprinklers, from sprinklers that are fitted with sprinkler guards, and from sprinklers that are not likely to be subject to damage due to construction activities or other events. In general, protective caps and straps should not be removed until construction activities or other events have progressed to the point where the sprinklers will not be subjected to conditions that could cause them to be damaged. Consideration should be given to leaving the protective caps and straps in place where other construction work is expected to take place, adjacent to the sprinklers following their installation, until that activity is complete. Protective caps and straps on sidewall and pendent sprinklers, for example, should be left in place pending installation of the wall and ceiling systems and then removed as finish escutcheons are being installed.

In retrofit applications, with minimal follow-on trade construction activity, and with upright sprinklers, it would be reasonable to remove the caps and straps immediately following the installation on the sprinkler piping.

A.5.2.3 CPVC is a plastic material, and consideration is necessary when other materials or chemicals come in contact with CPVC that can cause degradation of performance of the pipe due to interaction of materials. Other construction materials include, but are not limited to, materials used in the fabrication of the sprinkler system, additives to water supplies, cable and wiring, and certain insecticides and fungicides. Compliance with 5.2.3 combined with following the manufacturer's guidance on installation and compatible materials will help prevent premature performance degradation of nonmetallic piping. Mechanical stress caused by hanging methods or bending on nonmetallic piping beyond the manufacturer's recommended limitations can cause stress failure over time and should be avoided.

A.5.2.3.4 When fabricating steel pipe for a combination (CPVC–steel) system, the cutting oil and lubricants can cause performance degradation of the CPVC piping. Cutting oils and lubricants found to be compatible are available and should be used.

A.5.2.12.2 Not all fittings made to ASTM F437, *Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80*; ASTM F438, *Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40*; and ASTM F439, *Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80*, as described in 5.2.12.2 are listed for fire sprinkler service. Listed fittings are identified by the logo of the listing agency.

CPVC is a plastic material and consideration is necessary when other materials or chemicals come in contact with CPVC that can cause degradation of performance of the fitting due to interaction of materials. Compliance with 5.2.1.4 combined with following manufacturer's guidance on installation and compatible materials will help prevent premature performance degradation of nonmetallic fittings. Mechanical stress caused by hanging methods or bending on nonmetallic piping beyond the manufacturer's recommended limitations can cause stress failure over time and should be avoided.

A.5.2.12.2.1.3 When fabricating steel pipe for a system using non-metallic and steel pipe, the cutting oil and lubricants can cause performance degradation of the non-metallic fitting.

A.5.2.12.2.1.5 Rubber-gasketed pipe fittings and couplings should not be installed where ambient temperatures can be expected to exceed 150°F (66°C) unless listed for this service. If the manufacturer further limits a given gasket compound, those recommendations should be followed. Other construction materials include, but are not limited to, materials used in fabrication of the sprinkler system, additives to water supplies, cable and wiring, and certain insecticides and fungicides.

A.5.2.14.4 The intent of 5.2.14.4 is to provide assistance in determining the area of a building served by a particular control valve.

A.5.2.14.4.4 Care should be taken to ensure that all water supplies are isolated before work begins. Work on systems by shutting one valve and not knowing about another valve can result in unexpected water damage.

A.5.2.14.5.1 Backflow preventers that are "UL Classified" meet the definition of *listed* in accordance with this standard.

A.5.3 For underground pipe 4 in. (102 mm) in size or more (nominal dimensions), NFPA 24 should be used for the installation rules. For pipe under 4 in. (102 mm) (nominal) dimensions, NFPA 24 is not necessary.

A.5.4.2 Piping covered by insulation, as shown in Figure A.5.4.2(a) through Figure A.5.4.2(f), is considered part of the area below the ceiling and not part of the unheated attic area.

A.5.4.2(1) The use of antifreeze solutions in all new sprinkler systems should be restricted to listed antifreeze solutions only.

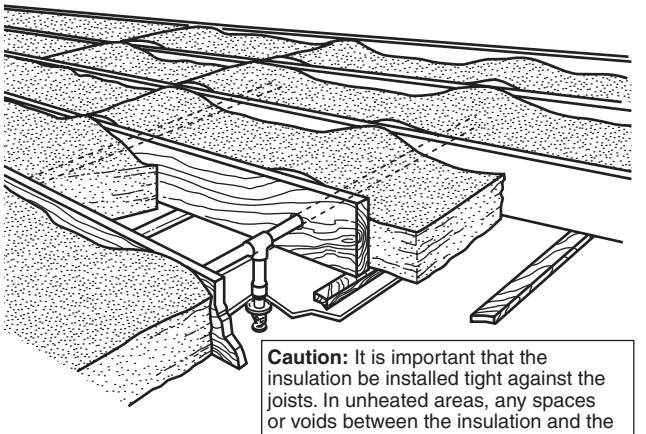


FIGURE A.5.4.2(a) Insulation Recommendations — Arrangement 1.

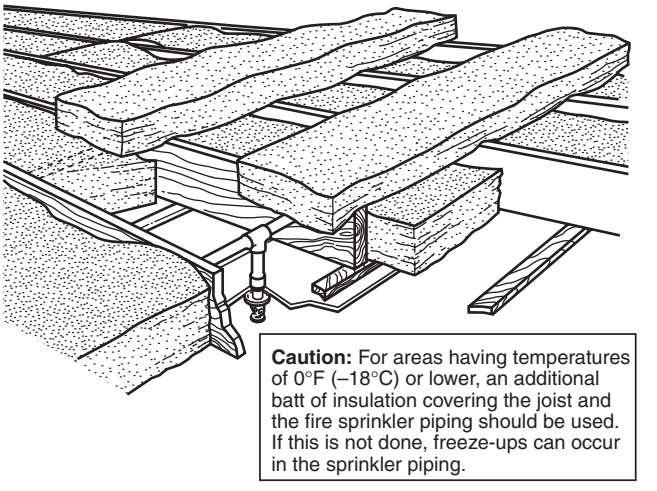


FIGURE A.5.4.2(b) Insulation Recommendations — Arrangement 2.

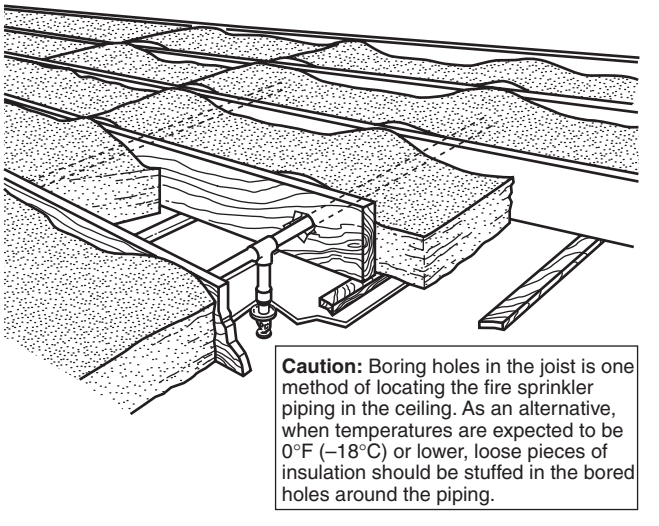


FIGURE A.5.4.2(c) Insulation Recommendations — Arrangement 3.

A.6.2.3.1 Sprinklers with a temperature rating of 135°F to 170°F (57°C to 77°C) are classified as ordinary temperature–rated sprinklers.

A.6.2.3.2 Sprinklers with a temperature rating of 175°F to 225°F (79°C to 107°C) are classified as intermediate temperature–rated sprinklers.

A.6.2.3.3 Care should be taken in positioning sprinklers in bathrooms near exhaust fan units. Some exhaust fan units have heaters built in to warm up the bathroom, and these units have the potential to activate sprinklers. Combination exhaust fan and heater units should be treated as wall-mounted diffusers for the purposes of using Table 6.2.3.3.3. Another area that should be avoided is directly in front of a vanity sink in a bathroom or dressing area with a low ceiling or over a kitchen sink. The use of hair dryers in vanity and bathroom areas can accidentally direct hot temperatures towards the sprinklers when installed above. In kitchens, sometimes

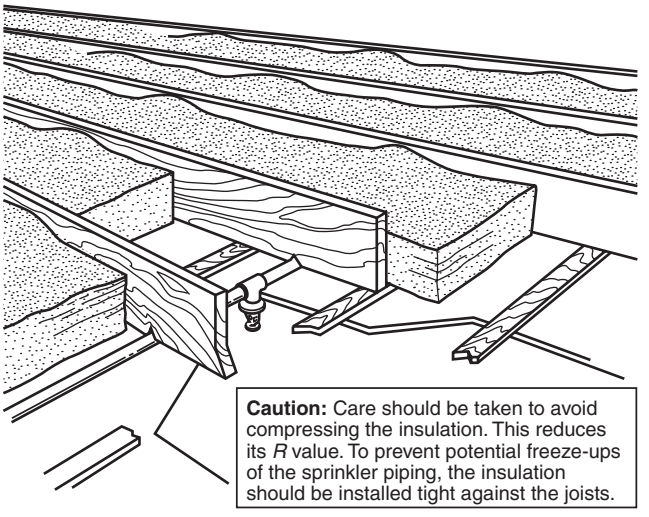


FIGURE A.5.4.2(d) Insulation Recommendations — Arrangement 4.

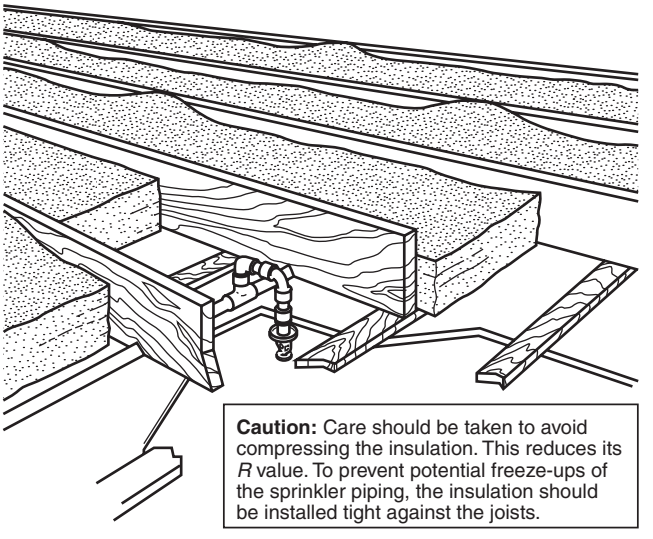


FIGURE A.5.4.2(e) Insulation Recommendations — Arrangement 5.

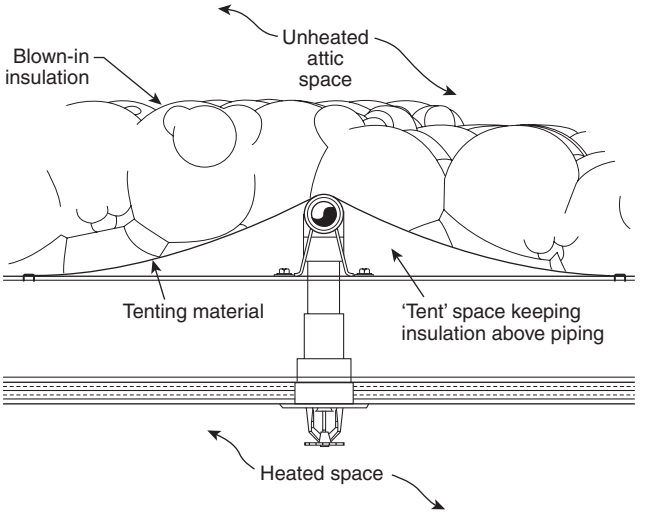


FIGURE A.5.4.2(f) Insulation Recommendations — Arrangement 6.

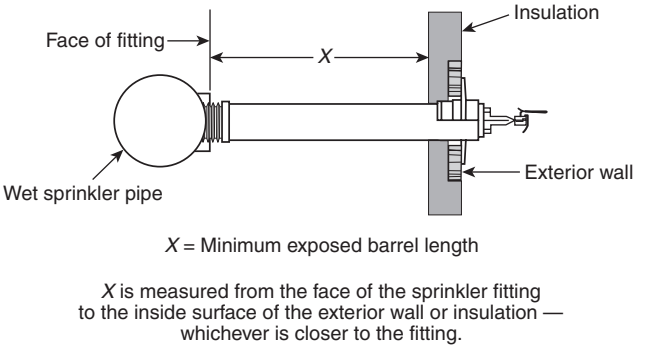


FIGURE A.6.2.4.1(a) Dry Sidewall Sprinkler Through Wall.

steaming hot water is dumped into the sink, which could affect a sprinkler installed directly overhead.

A.6.2.4.1 Dry sprinklers must be of sufficient length to avoid freezing of the water-filled pipes due to conduction along the barrel. The values of exposed barrel length in Table 6.2.4.1(a) and Table 6.2.4.1(b) have been developed using an assumption of a properly sealed penetration and an assumed maximum wind velocity on the exposed sprinkler of 30 mph (48 km/h). Where higher wind velocity is expected, longer exposed barrel lengths will help avoid freezing of the wet piping. The total length of the barrel of the dry sprinkler must be longer than the values shown in Table 6.2.4.1(a) and Table 6.2.4.1(b) because the length shown in the tables is the minimum length of the barrel that needs to be exposed to the warmer ambient temperature in the heated space. See Figure A.6.2.4.1(a) for an example of where to measure the exposed barrel length for a sidewall sprinkler penetrating an exterior wall and Figure A.6.2.4.1(b) for an example of where to measure the exposed barrel length for a pendent sprinkler penetrating a ceiling or top of a freezer.

The ambient temperature exposed to the discharge end of the sprinkler can be determined by using the lowest one-day mean temperature from Figure A.6.2.4.1(c).

A.6.4.4 Construction features such as large horizontal beamed ceilings, sloped ceilings having beams, and steeply sloped ceilings exist that are outside of the current listings. In these situations, sprinklers can be installed in a manner acceptable to the authority having jurisdiction to achieve the results specified in this standard. In making these determinations, consideration should be given to factors influencing sprinkler system performance such as sprinkler response characteristics, impact of obstructions on sprinkler discharge, and number of sprinklers anticipated to operate in the event of a fire.

A.6.4.6.3 Where the obstruction criteria established by this standard are followed, sprinkler spray patterns will not necessarily get water to every square foot of space within a room. As such, a sprinkler in a room with acceptable obstructions as

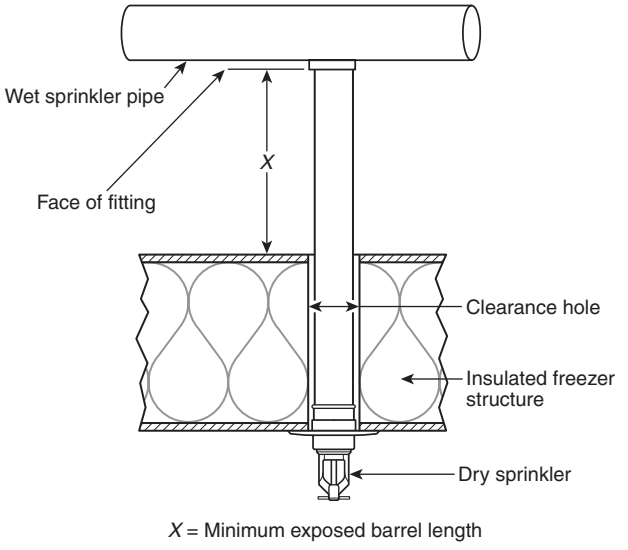


FIGURE A.6.2.4.1(b) Dry Pendent Sprinkler Through Ceiling or Top of Freezer.

outlined in this standard is not necessarily capable of passing the fire test (specified by ANSI/UL 1626, *Residential Sprinklers for Fire Protection Service*, and other similar laboratory standards) if the fire is started in one of these dry areas. This result is not to be interpreted as a failure of the sprinklers. The laboratory fire tests are sufficiently challenging to the sprinkler without additional obstructions as a safety factor to account for the variables that actually occur in dwellings, including acceptable obstructions to spray patterns.

The objective is to position sprinklers so that the response time and discharge are not unduly affected by obstructions such as ceiling slope, beams, light fixtures, or ceiling fans. The rules in this section, while different from the obstruction rules of NFPA 13, provide a reasonable level of life safety while maintaining the philosophy of keeping NFPA 13R relatively simple to apply and enforce.

Fire testing has indicated the need to wet walls in the area protected by residential sprinklers at a level closer to the ceiling than that accomplished by standard sprinkler distribution. Where beams, light fixtures, sloped ceilings, and other obstructions occur, additional residential sprinklers could be necessary to achieve proper response and distribution, and a greater water supply could be necessary.

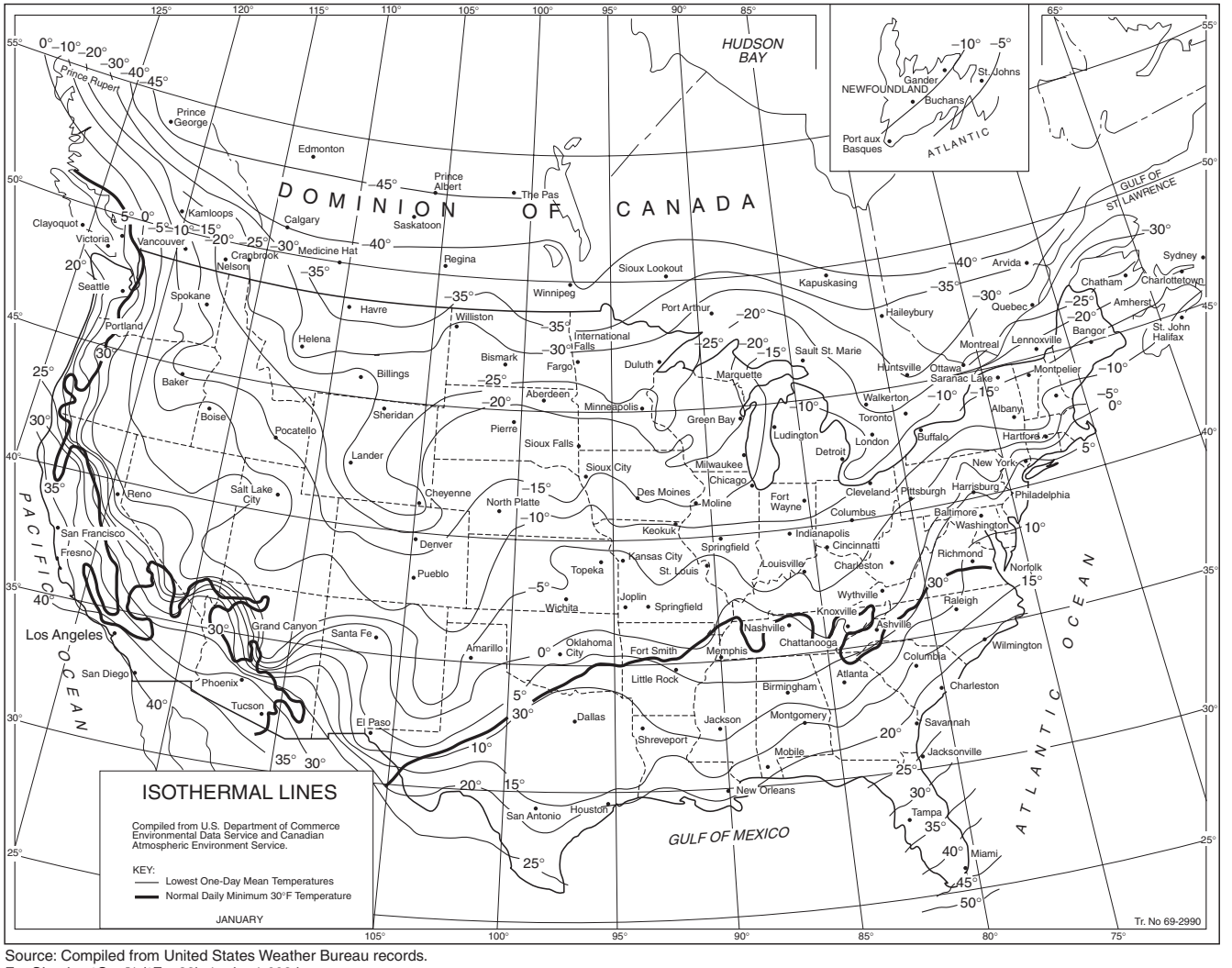
The requirements of 6.4.6.3.4 and 6.4.6.3.5 were developed from a testing series conducted by the National Fire Sprinkler Association and The Viking Corporation that included fire modeling, sprinkler response tests, sprinkler distribution tests, and full-scale fire tests (Valentine and Isman, *Interaction of Residential Sprinklers, Ceiling Fans and Similar Obstructions*, National Fire Sprinkler Association, November 2005). This test series, along with additional industry experience, shows a difference between obstructions that are tight to the ceiling and obstructions that hang down from the ceiling, allowing spray over the top. Residential sprinklers require high wall wetting, which means that they tend to spray over obstructions that hang down from the ceiling. The test series showed that the fan blades were not significant obstructions and that as long as the sprinkler was far enough from the fan motor housing (measured from the center of the housing), the sprinkler could control a fire on the other side of the fan in a small room. In larger rooms, the sprinkler needs to be augmented by additional sprinklers on the other side of the fan. The test series showed that the fan on low or medium speed did not make a significant difference in sprinkler performance. On high speed (pushing air down) the fan did impact sprinkler performance, but fire control was still achieved in small rooms. In larger rooms, it is expected that additional sprinklers would be installed. The test series also showed that the fan blowing down was more significant than the fan pulling air up.

The rules in 6.4.6.3.8 were developed from years of experience with NFPA 13 obstruction rules and an additional test series conducted by the National Fire Sprinkler Association with the help of Tyco International (Valentine and Isman, *Kitchen Cabinets and Residential Sprinklers*, National Fire Sprinkler Association, November 2005), which included fire modeling, distribution tests, and full-scale fire tests. The test series showed that pendent sprinklers definitely provide protection for kitchens, even for fires that start under the cabinets. The information in the series was less than definitive for sidewall sprinklers, but distribution data show that sprinklers in the positions in this standard provide adequate water distribution in front of the cabinets and that sidewall sprinklers should be able to control a fire that starts under the cabinets. When protecting kitchens or similar rooms with cabinets, the pendent sprinkler should be the first option. If pendent sprinklers cannot be installed, the next best option is a sidewall sprinkler on the opposite wall from the cabinets, spraying in the direction of the cabinets. The third best option is the sidewall sprinkler on the same wall as the cabinets on a soffit flush with the face of the cabinet. The last option should be putting sprinklers on the wall back behind the face of the cabinet because this location is subject to being blocked by items placed on top of the cabinets. It is not the intent of the committee to require sprinklers to be installed under kitchen cabinets.

A.6.4.6.3.1 Modern multifamily building floor plans incorporate certain architectural characteristics or features that can initially seem to make absolute coverage of every single square foot of floor area a challenge. These features include angled walls, wing walls, slightly indented walls, and various soffit configurations.

The "problem" arises when one erroneously considers water discharging from a residential sprinkler to travel only in an absolute straight line, as if it were beams of light. When this approach is taken, small [1 ft^2 to 3 ft^2 (0.09 m^2 to 0.28 m^2)] typically triangular "shadowed areas" can in theory be formed on the floor adjacent to their referenced architectural features. The shadowed areas are purely on paper and do not take into account the dynamic variables affecting sprinkler discharge and distribution. It is hardly conceivable that anything located within one of these areas could remain dry during adjacent sprinkler discharge. The committee recognizes that such small theoretically shadowed floor areas are not an issue. Residential sprinkler distribution patterns are specifically intended to provide superior wall-wetting capability. Survivability of the occupants is more dependent on such wall-wetting than on absolute floor coverage.

Though not specifically referenced as such, in fact, NFPA 13 already permits an appreciable amount of "shadowing" by way of the basic obstruction figures and tables for vari-



Source: Compiled from United States Weather Bureau records.
For SI units, °C = ⅝ (°F – 32); 1 mi = 1.609 km.

FIGURE A.6.2.4.1(c) Isothermal Lines — Lowest One-Day Mean Temperature (°F). [24:Figure A.10.4.2(b)]

ous sprinkler applications. Take, for example, Figure 8.10.6.2.1.3(a) of NFPA 13. Consider a residential sprinkler spaced 10 ft (3.05 m) off of wall. A 12 in. (305 mm) round column located in the direction of the wall and 4 ft (1.22 m) away from the sprinkler would create an allowable "shadowed" area of approximately 8.6 ft^2 (0.8 m^2), using the line-of-sight approach.

A.6.4.6.3.2 In such small closets, a single sprinkler installed at the highest point will help contain a fire by cooling the hot gases that will collect at the uppermost point. There can be many different obstructions that will prevent water from reaching all portions of the closet or compartment. Some common examples are as follows:

(1) Heating and air-conditioning closets where the plenum totally blocks the spray pattern and in some cases only 4 in. (101 mm) or less exists between the wall and the plenum for the sprinkler
(2) Globe or fluorescent lights in closets that hang down obstructing the sprinkler
(3) Closets under stairs that switchback where the spray pattern will not reach the low side

A.6.4.6.3.3.1 See Figure A.6.4.6.3.3.1(a) and Figure A.6.4.6.3.3.1(b). The obstruction shown in Figure A.6.4.6.3.3.1(a) is a vertical obstruction in a room similar to a column. Sprinkler response and water distribution tests have been conducted on such obstructions and the data shows that the size of the obstruction as well as the size of the compartment are critical variables to sprinkler response. A larger shadow area can be acceptable in a smaller compartment. The obstruction shown in Figure A.6.4.6.3.3.1(b) is a bump out of a wall. Sprinkler response and water distribution tests have shown that this type of obstruction is not a problem.

A.6.5.4 It is not the intent of this section to apply to sprinkler protection of glass atrium enclosures, pedestrian walkways, that are permitted by NFPA *101*, or model building codes to be protected by standard spray sprinklers installed in accordance with the special provisions set forth in those codes for atrium construction.

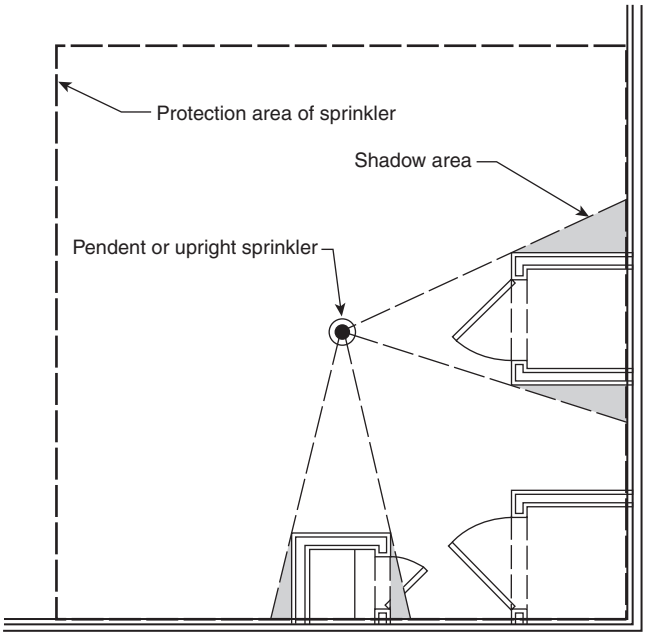


FIGURE A.6.4.6.3.3.1(a) Example of Shadow Areas (SSU/SSP).

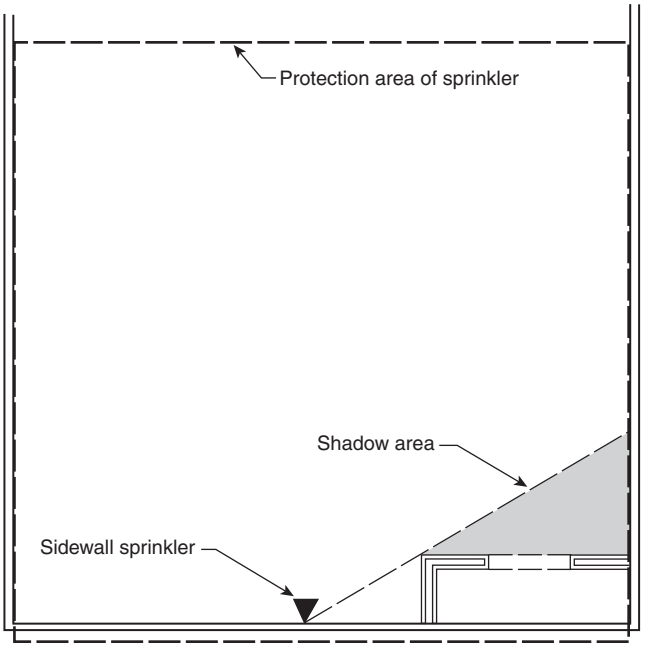


FIGURE A.6.4.6.3.3.1(b) Example of Shadow Areas (HSU).

A.6.6.2 A room is still considered a bathroom if it contains just a toilet. Additionally, two bathrooms can be adjacent to each other and are considered separate rooms, provided they are enclosed with the required level of construction.

A.6.6.4 Closets with washers and dryers, and other heat-producing mechanical equipment, are not considered clothes closets, linen closets, or pantries and therefore would require sprinklers.

A.6.6.5 An example of an open or exterior corridor, stair, or breezeway is one that is exposed to the outside atmosphere (temperature). Another example is an exterior wraparound corridor that is typical in a two- to three-story motel. *[See Figure A.6.6.5(a) through Figure A.6.6.5(e).]*

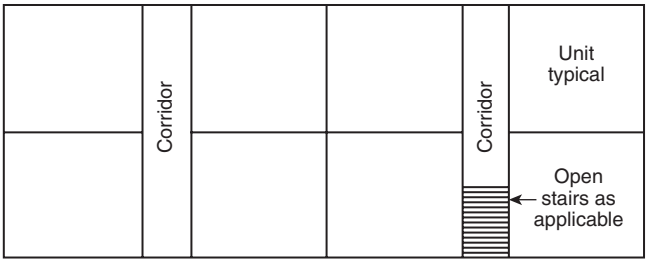


FIGURE A.6.6.5(a) Example of Open Corridor — Arrangement 1.

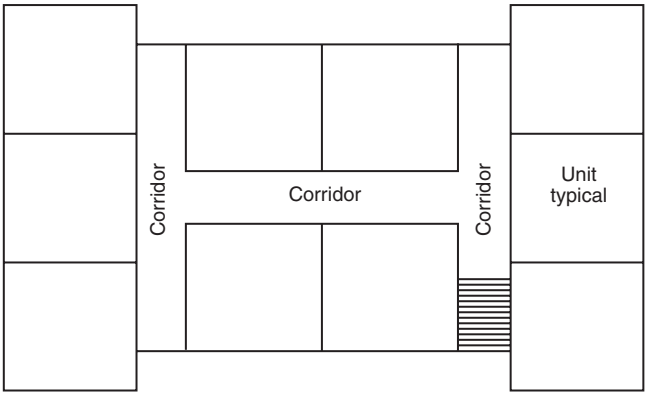


FIGURE A.6.6.5(b) Example of Open Corridor — Arrangement 2.

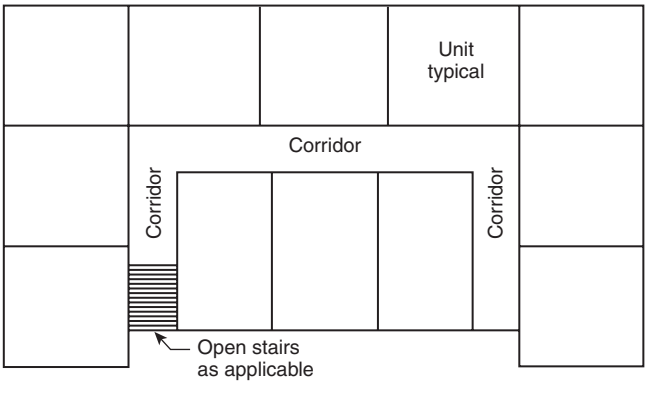


FIGURE A.6.6.5(c) Example of Open Corridor — Arrangement 3.

A.6.6.6 Concealed spaces are permitted to have small openings such as grilles for return air when the space is being used as a plenum. Such small openings do not disqualify the space from being considered as a concealed space, and sprinklers are still permitted to be omitted.

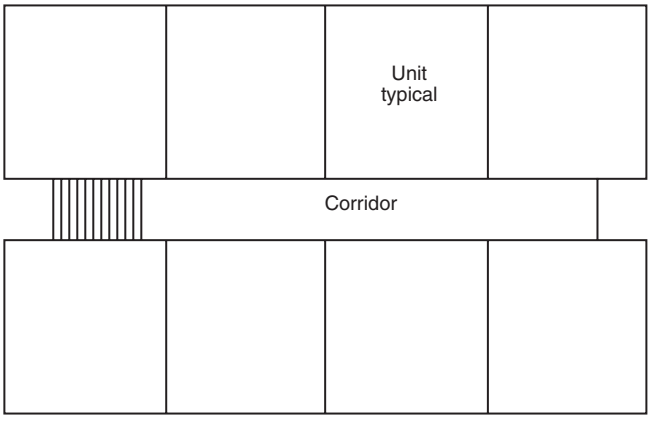


FIGURE A.6.6.5(d) Example of Open Corridor — Arrangement 4.

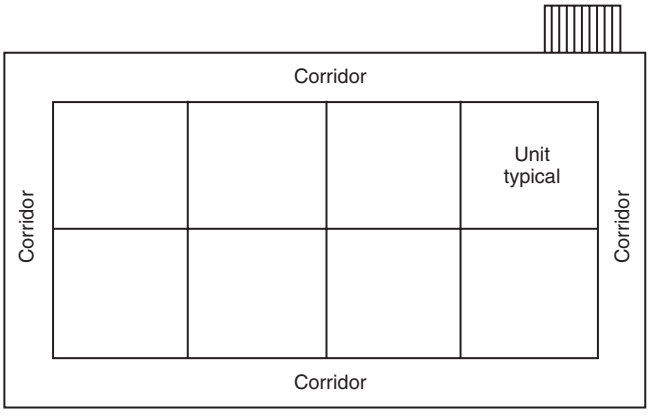


FIGURE A.6.6.5(e) Example of Exterior Corridor — Arrangement 5.

A.6.6.9.2 Sprinklers are not required to be spaced along the angled portion underneath stair risers in dwelling units. Stairways have a very small fuel load as they are used primarily for egress. Sprinklers spaced along the slope will likely not operate unless they are directly over a fire. Sprinklers installed at the landings on either end of the stair riser will provide the protection desired by this standard.

A.6.7.2.1 Where listed heat tracing is used on CPVC piping, it should be compatible with the CPVC piping.

Where insulation is being used (either above pipe in attic spaces or next to pipe within walls) to trap heat in order to prevent water-filled pipe from freezing, care shall be taken to make sure that the insulation stays in between the pipe and the cold side of the space. Insulation should not be allowed between the pipe and the warm side of the space, nor should the pipe be buried in the insulation. If the pipe gets buried in the insulation, or if the insulation gets between the warm space and the pipe, the insulation is doing more harm than good, keeping the warmth from the pipe.

A.6.8.8 System demand refers to flow rate and pressure. This test is only concerned with testing at the proper flow rate. The full flow test of the backflow prevention valve can be performed with a test header or other connection downstream of the valve. A bypass around the check valve in the fire department connector line with a control valve in the normally closed position can be an acceptable arrangement. When flow to a visible drain cannot be accomplished, closed loop flow can be acceptable if a flowmeter or site glass is incorporated into the system to ensure flow.

A.6.9 These connections should be installed so that the valve can be opened fully and for a sufficient time period to ensure a proper test without causing water damage. The drain should be designed and sized to verify the sufficiency of the water supply.

A.6.10 These connections should be installed so that the valve can be opened fully and for a sufficient time period to ensure a proper test without causing water damage. The test connection should be designed and sized to verify the sufficiency of the water supply and alarm mechanisms.

A.6.11 The fire department connection should be connected to the system riser. For single systems, it is an acceptable arrangement to attach the fire department connection to any point in the system, provided the pipe is at least the diameter of the fire department connection or as large as the riser, whichever is less.

A.6.11.5 See Figure A.6.11.5 for a sample of underground piping for fire department connections.

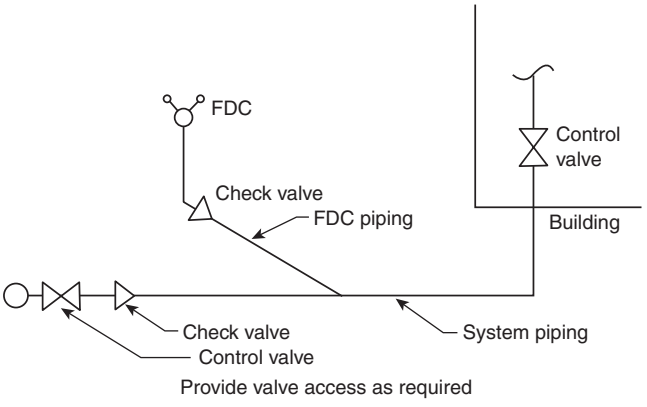


FIGURE A.6.11.5 Fire Department Connection Connected to Underground Piping (Sample 1).

A.6.13 Sprinkler piping should be adequately secured to restrict the movement of piping upon sprinkler operation. The reaction forces caused by the flow of water through the sprinkler could result in displacement of the sprinkler, thereby adversely affecting sprinkler discharge. Listed nonmetallic pipe has specific requirements for piping support to include additional pipe bracing at sprinklers.

A.6.16 The full flow test of the backflow prevention valve can be performed with a test header or other connection downstream of the valve. A bypass around the check valve in the fire department connector line with a control valve in the normally closed position can be an acceptable arrangement. When flow to a visible drain cannot be accomplished, closed-loop flow can be acceptable if a flowmeter or site glass is incorporated into the system to ensure flow.

A.7.1.1.1 Sprinklers need to be used in accordance with their listed areas and density. *(See Figure A.7.1.1.1.)*